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119  
"A New Luxury and a New Source of Economy."

THE  
Softening and Purification  
OF  
WATER.

"Thames water, after being softened, displays the beautiful blue-green tint of pure water, and resembles the Rhone as it emerges from the Lake of Geneva."—*Vide Report of the Royal Commission.*

PART I.

PRICE SIXPENCE.

F. H. ATKINS & Co.,  
ENGINEERS,

Authors & Publishers of

"HINTS TO SANITARY LEGISLATORS;"

"THE WATER SUPPLY TO COUNTRY RESIDENCES;"

"A NEW SYSTEM FOR THE FILTRATION OF WATER IN QUANTITY,"

&c., &c., &c.

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## INTRODUCTION.

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WE have made some endeavour in the following pages to make the subject of domestic water supply in private houses a little more interesting and a little less dull than is generally the case in works treating of this subject, by showing how intimately it affects, and in a measure controls, those smaller matters of domestic management, such as cooking, washing, bathing, &c., which, after all, make up the measure of the comfort and luxury enjoyed by a well-ordered household. We have reason to believe that much of the apathy and indifference undoubtedly exhibited by the public to the question of domestic water supply is caused by the fact that these considerations have been kept very much in the background. Thus it generally happens that in cases where private individuals make up their minds to spend money upon the improvement of the water supply to their homes, they do so with very small hopes as to the outcome. They do not feel sanguine that any very tangible and visible results will follow, but have a vague idea that the only consolation to be procured from their expenditure of money and trouble will be the satisfaction of having done something which is recommended for some mysterious and not very obvious reason by the "sanitary authorities" of the day as "the proper thing to do." That this, however, is a mistaken feeling, we think most who do us the favour to read this little treatise will be willing to allow. If, however, we have dwelt more upon such considerations than upon the question of health, we do not wish it to be inferred that we are disposed to undervalue the effects of bad water supply in this important direction—on the contrary we have every day experience which points to the opposite conclusion; and the instances of death and suffering from those diseases communicated by bad water afforded to the public latterly, in the families of Royalty, the illness of His Royal Highness the Prince of Wales, and the death of Her Royal Highness the Princess Alice and her children, and still more lately of Prince Waldemar of Prussia, &c., should bring the truth home to every mind, teaching as they do that none, however highly placed, are safe against the insidious dangers of an impure water supply.

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# A PURE SOFT WATER SUPPLY

TO

## COUNTRY RESIDENCES

CONSIDERED AS A

## COMFORT AND LUXURY.

---

ENGLAND is usually considered to be in advance of the whole world in all matters relating to health, comfort, and cleanliness, as exemplified in the internal economy and general arrangements of the private homes of all but the very poorest in the land. And no doubt, in a general way, it may be said that this is true, for the English are a cleanly, soap-and-water loving people, much given to bathing, washing, clean linen, and such-like little comforts or luxuries—whichever they may be considered. How comes it then that amongst the very highest in the country, even in the houses of the wealthiest and most respected of England's aristocracy, as well as of those of the well-to-do middle classes, the water supply used throughout the house, especially in houses of the kind known as "country mansions," is in the great majority of cases utterly unfit even to wash in, much less to drink, and in some, (a larger proportion than would be expected probably,) it is positively filthy? Is this true? And if it be true, how does it come about? can it be remedied? and if so, why is it allowed to continue?



As regards the question "Is it true?" we can say of our own knowledge alone that it *is* true. Being constantly called upon for advice in exactly such cases, and having visited professionally large numbers of such mansions situated all over the country, we can affirm that the state of things alluded to is the rule rather than the exception, among the otherwise luxurious, well-ordered country mansions of our aristocracy, gentry, and burgesses. As to the second question, "*Why* is it?" or "How has it come about?" it would be difficult, of course, to give a comprehensive answer off-hand, but we imagine that the chief reason is given in the words "increasing population." Old sources of water supply, rivers, wells, &c., are becoming every day more contaminated, while in the case of newly or recently built houses, there is less and less of free choice left as to locality and site, and hence architects and owners are less able to be particular nowadays in choosing a site *near* a good supply of water. However, whether the state of things under consideration may have arisen from one cause or another, is less important and less interesting than the queries, can it be remedied? and why is it tolerated?

Undoubtedly it *can* be remedied. We have met with a great number of different kinds of water, with a list of ever-varying characteristics as to impurities, colour, &c., &c., numerous almost as the sands of the sea (for we never in a long experience have found two samples exactly alike), but we never yet met with water so foul or so difficult to deal with that it could not be rendered wholesome and fit for domestic use by proper treatment.

It is, of course, in many cases a question of expense, for

the more impure the water naturally the greater the cost of so converting it. Nor do we say it is necessary always to adopt this course in order to obtain an improved water supply in any given instance. Sometimes the practised eye will light upon some other source, sufficiently near and available, the adoption of which may be preferable to purifying the supply already laid on.

Nevertheless, the *worst* supplies *can* be purified where necessary, and hence we come to the last enquiry indicated.

WHY IS IT THAT THIS UNCLEANLY STATE OF THINGS IS TOLERATED AND ALLOWED TO CONTINUE IN HOUSES, THE WEALTHY OWNERS OF WHICH CAN WELL AFFORD TO HAVE IT REMEDIED, AND WHO, ONE WOULD THINK, WOULD BE PEOPLE LIKELY TO SET CONSIDERATIONS OF HEALTH, CLEANLINESS, AND DECENCY, ABOVE ALL CONSIDERATIONS OF EXPENSE?

This question is one to which it is difficult to find a satisfactory answer.

Is it a mere question of expense? We are inclined to think not. To a man of the position we allude to, the expense would be a mere bagatelle. The owner of valuable horses, the buyer of pictures and old china, the landed proprietor, the man who can afford to spend hundreds, nay thousands, on the purchase of a single picture, or the decoration of a single room, would he be deterred from spending a few hundreds—or it might be only one hundred, or half a hundred—by considerations of the mere cost?

We can understand such a man saying, with a smile—as many have said to ourselves—"I don't drink much water myself, you know." But still he is anxious for the health and



comfort of his wife and children, who *do* drink water, and their safety from the diseases propagated by impure water must surely be a more serious object to him than any reasonable outlay.

Then whence comes the indifference or the carelessness, or the recklessness—which you will—that continues to tolerate the uncleanness and danger of an impure water supply, and refuses to be at the cost of altering it?

This problem we have said is a difficult one, and we cannot find a solution of it which explains it quite satisfactorily; but we are rather inclined to think that it may be put down in a great many cases to the fact that comparatively few people have any adequate idea of the COMFORT AND LUXURY of a plentiful supply of pure and soft water.

To refer to our own experience, in the letters from clients we have received at various times expressing their pleasure and satisfaction at the success of the arrangements we had designed, the frequent use of the words “comfort” and “luxury” has been particularly noticeable, “We find it such a comfort,” “I consider it a great comfort,” “Such a luxury;” &c., &c., from all which we may assume that the writers never had an adequate idea of the great comfort and luxury of plenty of good water until they actually realized them. And, undoubtedly, there are many reasons why this might be so. If we consider, for instance, *how gradual* has been the growth of that deterioration in water supply attributable to growth of population, &c., we shall then understand how, having for generations been getting *gradually* more and more accustomed to ever increasing impurity in water, it requires quite an effort of the imagination to realize what “pure, soft water all over the house” really means.

To any one who finds a difficulty in realizing what a pure water supply means, we would recommend a little trip, a holiday outing, to Watford, to visit the Colne Valley Water Works at Bushey, near that place, where the water is both softened and rendered beautifully pure by what is known as Clark's process. Let him see the pure water lying in the tanks there, lustrous with its exquisite turquoise blue tinge (the natural colour of pure water\*), looking more like the transparent far-reaching azure of the summer sky than anything he had previously associated with domestic water supply. So clear, so translucent is it, that a pin can be seen distinctly at the bottom of 12 or 14 feet of water, and so ethereal-looking that one can hardly realize that such an impalpable looking film could really support a human body, or that it would be quite safe for a swimmer to jump into it. A pin lying at the bottom, a stone, or a bolt head, appears so distinctly, it is difficult to believe we really see it through such a depth of water; while even on the most gloomy and dismal of days, with a leaden sky overhead and a drizzling rain falling, we have seen the remarkable blue tint as distinct and unmistakeable as the blue of the sea waves off Dover on a fine summer day, only lighter in tone.

This brilliant blue tint is usually very striking and impressive to those who see it for the first time, and seldom fails to call forth an expression of astonishment and delight.

Let such a person then return and view the water arrangements of his own house, which previously he had thought tolerable.

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\* See foot note, page 49.



*Let him take a peep into the cistern,* (if he can get at it to peep into,) mark the sullen turbid look of its contents, and the cistern's slimy sides, and compare the difference between the feeling of jumping into such a mess and "taking a header" into the brilliant blue element he had seen that day. We know of no greater contrast than that thus suggested, and we cannot doubt but that everyone who has visited these works must have been impressed by similar feelings, and must have felt their irresistible force.

Let then such a person understand that he too can have such a supply at his own home; that the process carried out at those works can now be applied on a small scale for country mansions, and it would be remarkable indeed if, being able to afford it, he should hesitate any longer about introducing such a luxury for the use of himself and his family.

But besides the luxury of washing and bathing, we have a perfect *multitude* of small comforts and advantages flowing from the introduction into a household of such a supply of soft water as is here referred to.

Thus, bad water stains the linen and the paint of halls and staircases, and the boards of floors, &c., washed with it. It spoils the flavour of tea, the appearance and taste of spirits with which it is mixed, furs the boilers, stops up the pipes, and is the cause of a hundred other annoyances and nuisances in every day life WHICH PEOPLE ONLY PUT UP WITH BECAUSE THEY HAVE ALWAYS LOOKED UPON THEM AS INEVITABLE, AND HAVE NEVER CONTEMPLATED THE POSSIBILITY OF ESCAPE FROM THEM. Once, however, the pure soft supply becomes available, all the linen in those houses to which a laundry is attached and where

the washing is done at home, from shirts and collars to table cloths and dinner napkins, becomes a totally different colour; the tea a different flavour; the glass of grog has a different taste and appearance; the house throughout looks more cheerful, cleaner, brighter, fresher, gayer—no workmen are ever called in to pull about pipes and boilers that have stopped up, no water bottles look dirty with coatings of sediment; even the horses in the stable have a better appearance.

These, and a hundred other advantages, flow from improved water supply, leaving out of sight altogether the question of the health of children, ladies, and those members of the household who habitually drink water; and, will anyone say that such advantages are not worth acquiring in the modern mansion if they can be had for a moderate outlay? We think few will deny it, but rather admit that as much may be said in favour of a supply of pure soft water from the standpoint of "comfort and luxury," as for a great many of the so-called esthetic ideas, and unsatisfying transient luxuries in the pursuit of which men of position and means every week, every day, spend ten times as much, merely to please a passing whim or sudden fancy; while all the time leaving their homes absolutely destitute of the very first essentials towards those considerations which should be the first thought and pride of all English gentlemen, viz.—

**CLEANLINESS, CHEERFULNESS,  
HEALTH & COMFORT!!!**



**The Preceding Remarks confirmed by reference to the highest Scientific Authorities of the day, and to the Reports of Royal Commissioners, &c.**

WITH reference to the relative advantages and economy attending the use in ordinary domestic concerns of soft pure water, as against hard, impure water, the report of the Royal Commission, issued in 1874, contains such a mass of carefully selected evidence upon this particular point, that it may be considered in every way complete and conclusive. We, therefore, cannot do better than make a few extracts from this report bearing upon those points which are of the most general interest.

Her Majesty's Commissioners report as follows:—

*Boiling, infusions, decoctions, extracts, &c.*

*Economy in making tea.*

*Economy of fuel.  
Brewing.*

“As regards all processes in which substances are submitted to boiling, or to simmering, at a high temperature, soft water has an acknowledged superiority over hard water; a superiority which, as it economises the material on which it operates, HAS A DISTINCT MONEY VALUE. In the extraction of tea from the leaf, as well as in the extraction of juices from meat in the preparation of soups, a smaller quantity of the material thus suffices for the production of an extract of a given strength, and as the process is not only more effectual, but more easy, time and fuel are also saved. The same truth obtains in the experience of the brewer, who prefers a soft water for the rapid and effectual extraction of the saccharine matter of malt in the preparation of his work; who only uses hard water when he desires to prevent the too easy solution

and extraction of the colouring matter of malt. Even in the cooking of meat and vegetables, where it is not the extract but the solid food that is the desired result, it is alleged by experienced witnesses that the result is more satisfactory when soft water is used."

In their "Summary" of evidence upon this point the Commissioners say :—

"In cooking, the extraction of the soluble parts of *Cooking*. such materials as are submitted to boiling, or to digestion, at a high temperature, is more completely and economically effected by soft than by hard water."

The following testimony on these points is quoted from the minutes of evidence taken before the General Board of Health in the year 1850. Monsieur Soyer gave *Mons. Soyer's evidence as to cooking.* the following evidence :—

Q. "You are known to the Commissioners from your writings on cookery; and you have doubtless had occasion to try the qualities of different waters for cooking and culinary purposes; you have probably used Thames water?—A. Yes, I have; when I first became cook to the Reform Club we occupied Gwydyr House, which was then supplied with Thames water.

What was your experience of it?—That it was very hard and inconvenient; it had sometimes a disagreeable taste; it was at all times very hard.

What was the effect of the hardness in cooking?—That in many processes we were obliged to use potass or soda for the water, to soften it.



*Effects on  
asparagus,  
cabbage,  
greens,  
French beans,  
green peas, &c.*

What were the processes?—First, in boiling cabbage, greens, spinach and asparagus, &c., hard water gives them a yellow tinge, especially in French beans; hard water shrivels green peas, and will be more particularly noticed in French beans; the process of boiling is also longer.

*More fuel  
required.*

That requires more fuel?—Certainly.

What would be the difference in time?—With dry vegetables, certainly one-fourth more.

*Effects in the  
cooking of  
potatoes,*

How is it with potatoes?—I do not think it acts so much upon potatoes, but still it has an influence upon all sorts of vegetables. I do not see the same effects, however, upon roots generally, as upon leaves generally; the effects are very powerful.

*Fresh and salt  
meat.*

What do you find to be the effect of hard water upon the animal foods?—Upon salt beef the hard water is not so good; it does not open the pores of the meat so freely as soft water. On fresh meat it likewise has a prejudicial effect, but not equal to that on vegetables. It has the effect of making very white meat whiter than the soft water. Upon all delicate things it has a much more marked effect; for example, in making beef tea, chicken or veal broth, or upon lamb, AND THE MORE DELICATE A SUBSTANCE IS THE GREATER IS THE INFLUENCE OF A HARD WATER UPON IT. A hard water, as it were, compresses the pores, whilst a soft water dilates them and the succulent matter which they contain. It makes them more nutritious. The evil of hard water is more visible in small quantities, such as beef tea or broth.

*Making beef  
tea.*

Then it will be the more prejudicial or expensive in domestic economy, which must be in small quantities?—

Exactly so; in the larger operations, where there is much boiling, the boiling itself, and for a long time, reduces the hardness.\* In the smaller quantities requisite for invalids and delicate persons, the disadvantages are the most experienced. When I used Thames water at Gwydyr House I have had small quantities boiled in order to soften it, and have then let it get cool and kept it ready for use for the smaller operations.

*Effects on  
broth, beef  
tea, &c., for  
invalids and  
delicate  
persons.*

What is the effect of hard water upon bread?—I have not had practical experience in bread making, but there is not the least doubt that soft water is of the greatest importance as making the best bread. This is exemplified in Paris where the water is hard and where that bread which is made in imitation of Gannes bread, though made with the same flour and by the same bakers, never equals that made at the place itself, where the water is soft. I am informed that part of the water at Glasgow is very soft, and that the Scotch bakers from thence, when they first come to London, cannot understand why the bread does not rise so well as in Glasgow, even though they made use of the same yeast and flour.

*Home-made  
bread.*

*Paris bread  
and Gannes  
bread.*

*Scotch bread.*

*London bread.*

What is your experience in respect to tea?—The hard water is injurious in deteriorating the flavour; it also requires more tea to give it equal strength. There can be no doubt that the softer water is of very great importance.

*Tea.*

In respect to coffee, what is your experience?—Hard water produces a similar effect, but not quite so powerful.

*Coffee.*

\* This means that boiling deposits the carbonate of lime; but the lime thus deposited is partly found encrusted on the vegetables, &c., cooked in the water, thus entirely spoiling their flavour.

[illegible]

The next experiment I will now make is to see what the use of salt water is in boiling meat.—Having now made a few trials several experiments with both soft and hard water, first with vegetables: first a marrow, marrow, and second, an artichoke, pieces of which are both long and in regard of its hard surface present a very singular, with the same quantity of water and in the same fire above: those boiled in the soft water were quickly done, and the flavour of the vegetables in the water which they boiled in the hard water never became tender nor did the flavour go into the water.\* Secondly, with potatoes I saw a period passed in 1791 and boiled the pieces at the same time in the same waters, the difference was nearly distinguishable, that which was boiled in the hard water being earlier done at the same time water. Thirdly, in extracting the juice of gravy from meat: the soft water does so quickly and well, but the hard water, instead of opening the meat, seems to draw it closer together, and to solidify the fibres, and I believe that the true flavour of the meat cannot be extracted by hard water.\* In boiling salt meat less salt is extracted when boiled in hard water, and at the same time the meat is not so tender as when boiled in soft water. Soft water evaporates one-third faster than hard water."

\* Showing the difficulty of making soups with hard water, either from vegetables or meat.

Professor CLARK, of Aberdeen, gave the following evidence :—

“From preliminary experiments made, it appeared that hard water was very unfit for the purpose of infusing tea. In making use of a series of waters at 4°, 8°, 12°, 16° of hardness, the strength of the infusion, as manifested by the depth of colour produced, was evidently in a series such that each infusion could be sensibly distinguished from the one next to it, above or below, the hardest water giving the least depth of colour, and the softest the greatest.”

Evidence on this subject was given before the Royal Commission on Water Supply (1869). The greater economy in the household from the use of a soft water was generally admitted.

**With respect to washing, the Report says:—**

“The superiority of soft water in the laundry, partly owing to its greater power of dissolving either filthy matters or those adhesive substances by which they cling, is experienced also in the kitchen, where this power of solution on the part of water is a property of great importance.” *The value of soft water in the laundry.*

**Subsequently, in summing up all the evidence upon this point, the Commissioners say:—**

“The washing of linen can ONLY be performed with soft water. If the available water be hard, it must be artificially softened, an operation which, on the domestic scale, must be performed at great expense by the aid of



From these experiments and your extensive knowledge, will you state the general results as to the relative power of the hardest and the softest water in making tea?—I should say that whilst with the hard water three cups might be made, with the soft water about five might be made.

*Cooking of  
vegetables.*

What extra expenditure of tea, then, would the use of Thames water incur in making tea?—NEARLY ONE-THIRD. I have made several experiments with hard and soft waters; first with vegetables; that is, carrots, turnips, and onions, cut into small pieces of about one inch long and an eighth of an inch square, placed in two saucepans, with the same quantity of water and on the same gas stove: those cooked in the soft water were quickly done, and the flavour of the vegetables in the water, whilst those cooked in the hard water never became tender, nor did the flavour go into the water.\* Secondly, with potatoes, I cut a peeled potato in two and boiled the pieces at the same time in the above waters; the difference was easily distinguishable, that which was boiled in the hard water being harder but at the same time whiter. Thirdly, in extract-

*Extraction of  
flavour and of  
gravy from  
meat.*

*How to make  
meat tender.*

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What extra expenditure of tea, then, would the use of Thames water incur in making tea?—NEARLY ONE-THIRD. I have made several experiments with hard and soft waters; first with vegetables; that is, carrots, turnips, and onions, cut into small pieces of about one inch long and an eighth of an inch square, placed in two saucepans, with the same quantity of water and on the same gas stove: those cooked in the soft water were quickly done, and the flavour of the vegetables in the water, whilst those cooked in the hard water never became tender, nor did the flavour go into the water.\* Secondly, with potatoes, I cut a peeled potato in two and boiled the pieces at the same time in the above waters; the difference was easily distinguishable, that which was boiled in the hard water being harder but at the same time whiter. Thirdly, in extracting the juice or gravy from meat; the soft water does so quickly and well, but the hard water, instead of opening the meat, seems to draw it closer together, and to solidify the gluten, and I believe that the true flavour of the meat cannot be extracted by hard water.\* In boiling salt meat less salt is extracted when boiled in hard water, and at the same time the meat is not so tender as when boiled in soft water. Soft water evaporates one-third faster than hard water."

*Cooking of  
vegetables.*

*Extraction of  
flavour and of  
gravy from  
meat.*

*How to make  
meat tender.*

---

\* Showing the difficulty of making soups with hard water, either from vegetables or meat.

Professor CLARK, of Aberdeen, gave the following evidence :—

“From preliminary experiments made, it appeared that hard water was very unfit for the purpose of infusing tea. In making use of a series of waters at 4°, 8°, 12°, 16° of hardness, the strength of the infusion, as manifested by the depth of colour produced, was evidently in a series such that each infusion could be sensibly distinguished from the one next to it, above or below, the hardest water giving the least depth of colour, and the softest the greatest.”

Evidence on this subject was given before the Royal Commission on Water Supply (1869). The greater economy in the household from the use of a soft water was generally admitted.

**With respect to washing, the Report says:—**

“The superiority of soft water in the laundry, partly owing to its greater power of dissolving either filthy matters or those adhesive substances by which they cling, is experienced also in the kitchen, where this power of solution on the part of water is a property of great importance.” *The value of soft water in the laundry.*

**Subsequently, in summing up all the evidence upon this point, the Commissioners say:—**

“The washing of linen can **only** be performed with soft water. If the available water be hard, it must be artificially softened, an operation which, on the domestic scale, must be performed at great expense by the aid of

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either fuel, soda, or soap. In personal ablution also, the use of soft water is much more pleasant and efficient. It is also more economical; but by the general use of a very small quantity of water, the waste of softening material is here much less than in the laundry."

*Choking up of  
boilers and  
pipes.*

The late Professor W.A. MILLER, M.D., F.R.S., said:—

"I think that one of the principal objections to hard water is the manner in which deposits take place from it when it is used in boilers. There is always in a chalk district a considerable deposit of adherent fur in the inside of boilers, kettles, kitchen ranges, and so on, which in time chokes the range and obstructs the passage of heat and may occasion accidents; that seems to me to be one of the serious practical inconveniences from hard water."

*Danger of  
accidents.*

Dr. ROBERT ANGUS SMITH, F.R.S., Chief Inspector of Alkali Works, says:—

*The stable,  
Effects upon  
horses.*

"I have heard of horses losing their appearance through drinking hard water, and of persons of my acquaintance who got indigestion by coming into hard water districts."

Dr. WILLIAM FARR, F.R.S., Superintendent of the Statistical Department of the General Registry Office, says:—

"I remember going over JOHN DAY's training establishment at a time when he had some hundred horses training. His establishment was situated on the chalk, where the water was hard, and he said he gave them nothing but rain water, and that they would not drink the hard water."\*

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\* See extracts from testimonials, page 68.

**As regards the effects of soft, as against hard, water in relation to health, Her Majesty's Commissioners say:—**

“The question of the comparative wholesomeness of soft and hard waters has for many years past received the attention of the highest medical and chemical authorities. *Influence of hard or soft water upon health.* The general result appears to be that whilst, on the one hand, opinions have differed considerably as to the wholesomeness of hard water, on the other there has been, and is now, AN ALMOST COMPLETE UNANIMITY AS TO THE WHOLESOMENESS OF SOFT WATER. In their report on the water supply of the Metropolis by the General Board of Health, presented to Parliament in 1850, the following evidence on this subject is adduced.”

Dr. JOHN SUTHERLAND, speaking of the water at that time supplied to Liverpool, and which was of about the same hardness as the water at present supplied to London from the Thames, says:—

“Having lived for a number of years in Liverpool, a town which has a supply of very hard water for domestic use, my attention for a length of time has been called to the fact that the continued use of this water has a somewhat peculiar effect on the digestive functions in certain susceptible constitutions. \* \* \* After some experience and observation, both in myself and others, I arrived at conclusions which I frequently expressed several years ago, and which nothing has since occurred to alter, and these are, that in the class of constitutions referred to, the hard

water tends to produce visceral obstructions, that it diminishes the natural secretions, produces an irregular state of the system, and consequently deranges the health."

The late Dr. TODD THOMPSON states in his work on the domestic arrangement of the sick room:—

"And either distilled water, or rain, or other soft water filtered, are the only kinds proper for the use of the sick room. Hard water, under whatever name it is found, whether as spring water, or pump water, or well water, should be excluded."

The Board of Health state (Report on the Supply of Water to the Metropolis, 1850), that "Apparatus for the distillation of water having been proposed to be introduced on board the French Navy, the French Government appointed several medical commissions to give distilled water to the men and observe the effects upon them. The trials were made separately, and the results were reported to be uniformly favourable."

Dr. LEECH, of Glasgow, with reference to the Gorbals Gravitation Water Works of that city, states:—

"It was the unanimous opinion of the medical profession, that great benefits of a sanitary kind had followed on the substitution of the soft water for the hard water supply hitherto in use. It has been observed that since this change urinary diseases have become less frequent, especially those attended by the deposition of gravel. So far as experience has gone, my own opinion is that dyspeptic complaints have become diminished in number."



In commenting upon this evidence, the Commissioners express the following opinion:—"On the whole, from much evidence of the same tenor as that we have cited, we cannot doubt that the presence of lime and other mineral matter deteriorates the wholesomeness and value of water for the purposes of drinking."

The Right Hon. LYON PLAYFAIR, C.B., M.P., F.R.S., late Professor of Chemistry in the University of Edinburgh, speaking of Thames water, says:—

"In all cases I advise towns not to accept hard water. Within the last three or four weeks I have been consulted with regard to supporting a Bill in Parliament for a water supply to a town, and I refused to support it because it had a water with twenty degrees of hardness. \* \* \* As to the advantages from cleanliness, both with regard to personal cleanliness and washing, I look upon it as a matter of great importance that soft water be used, and I think it decidedly conducive to the health of a town, especially among the lower order of the people. \* \* \* Lime in water is not necessary for the formation of bone, because the lime required in food does not come from the water, but from the solid articles of food taken, and I do not think that the lime in water has any advantageous influence on the processes of healthy nutrition."

The late Dr. EDMUND A. PARKES, F.R.S., Professor of Military Hygiene in the Army Medical School at Netley, says:—

"With regard to the effect upon health of the use of

hard waters, the carbonate of lime waters appear in some cases to produce some effect upon health;—for instance, dyspepsia, and they do not agree with some class of persons. Indigestion is sometimes caused by hard water."

Dr. WILLIAM FARR, F.R.S., Superintendent of the Statistical Department of the General Registry Office, says:—

"A change of water has an effect upon people. For instance, on changing from a soft water to a hard water, going into a limestone district where the water comes from the magnesian limestone, many people are made ill for a time."

Dr. GEORGE C. PRIE, M.D., Medical Officer of Health for Dundee, says:—

"Stone in the bladder was a very common ailment in Dundee, but during the last ten years I have not been aware of more than two or three cases. I cannot explain it in any other way than that the water, before the people used the present supply, was well water, which contained more lime and more salts, and therefore gave rise to stone in the bladder."

As regards Cholera, the Commissioners say:—

*Cholera.*

" \* \* \* Of all epidemics, cholera is the one whose habits have been most thoroughly exposed by these statistics; and it was proved *beyond all question* by the analysed returns of the General Register Office, that the fatality of the disease bore a very constant ratio to the quantity of sewage in the water of the several Metropolitan Waterworks Companies."



## The Scientific and Common Sense Treatment of Water.

By the above heading we mean the treatment or purification of a given sample of water, by means and with materials especially suited to and applicable to that particular kind of water, ascertained by careful analysis and a series of preliminary experiments, as distinguished from its hap-hazard treatment, by applying to all kinds of water a certain material or machine as though that material or machine were a sort of magic charm, with the power of removing ALL the enormous number and variety of impurities found in samples obtained from different sources.

It is very necessary to bear in mind that we seldom or never meet twice with exactly similar samples of water,\* and no particular material or method ought, therefore, to be relied upon for general application as regards filtration and purification.

A certain process or material may succeed admirably in this case, or that, and may fail utterly in others; and no engineer or chemist undertaking the treatment of water supply should allow himself to be prejudiced in favour of any particular system or material.

Each case of water supply is, indeed, an engineering problem in itself, to be considered and treated upon its own

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\* It is found that water drawn from different houses in the same street, and supplied by the same main, will differ in quality according to the distance of the house from the end of the main; and samples drawn from the same tap differ from day to day, and even from hour to hour.



merits, and according to the special requirements and surrounding circumstances of the case. This is the only rule that can be given, and it is in accordance with common sense; for to apply the same material or the same apparatus to the ever-varying kinds of water one meets with, would be like applying one single remedy to all diseases, or expecting a coffee mill to do anything—from grinding coffee to crushing granite.

In medicine it is usually understood that only quacks attempt to puff off one particular medicine as a specific for all complaints, and something of the same sort may be said about filtration. The purification of water, like the treatment of disease, should be founded upon a careful diagnosis of each particular case, but this can only be done successfully by those who have made it their special study, and who have had special experience. As in medicine, so in water supply—the most difficult-looking cases are sometimes the easiest, and require the most simple and inexpensive remedies, while at other times the most simple-looking are really the most difficult.

We wish it, therefore, to be understood that in recommending a process or system in the following pages, we only speak of its application to the kinds of water, to which it is suitable; and that for some particular kinds of water modifications, or even totally different systems, are necessary.

These points are decided by analysis and preliminary experiments with samples.

## Water Softening,\* or the Chemical Treatment of Water, by what is known as the Clark Process.

The late Dr. CLARK was one of the most successful of those who have brought chemistry and science to bear upon the question of water supply, for he discovered a process or principle which is applicable to a *whole class, and that the largest class, of waters*. That is, all those kinds which contain a considerable proportion of carbonate of lime. In this simple process, a solution of lime water is added to the water to be treated, and allowed to stand for a certain time, when the lime added combines with the carbonate of lime already in the water, and the whole falls to the bottom in the form of an INSOLUBLE PRECIPITATE, and CARRYING WITH IT ORGANIC MATTER or *other impurities present in the water*. The clear water is then run off, and is found to be pure, soft, and, generally speaking, of that wonderful blue tint before alluded to. (See pages 9 and 49).

So perfect and beautiful are the simplicity of the process and the results attained, that one is led to wonder that it has not been more extensively adopted, especially as there is now no patent for the original process. At Canterbury and other places this process has been in use for years, and has worked very satisfactorily indeed. More recently it has been carried out at the Colne Valley Water Works, near Watford, Herts; and latterly, as many will be doubtless aware, much has been talked and written upon the question of applying it to the entire water supply of the metropolis.

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\* The softening process ALSO PURIFIES the water treated, and in all cases, therefore, in which we speak of water softening, the word "purification" is understood.



It has also of late appeared to find favour with institutions and large private establishments, on account chiefly of its great economy and other advantages; indeed, almost a fashion would appear to have set in in regard to the use of this process, and deservedly so, for of all methods of water purification, with which we are acquainted, there is none which is more satisfactory or perfect in its operation than this.

In many cases it is to be preferred to filtration in the sense in which that word is usually understood, since filters wear unequally unless kept very regularly and constantly cleaned; while the CLARK process, properly designed and carried out, works evenly and smoothly for any length of time.

The Royal Commissioners, from whose Report we have already made many extracts, speak of it in the highest terms, and recommend its adoption in every case to which it is applicable, bringing to bear in its favour a mass of argument, scientific opinion, and actual known facts, which are absolutely irresistible.

It would, indeed, be difficult to find any other point connected with water supply with regard to which there is such a unanimous agreement of the best scientific authorities.

As it is not possible for us to give here any adequate idea of the amount of incontrovertible testimony they have collected, we must content ourselves with a few extracts sufficient to illustrate and confirm our statements.

They say:—

“ In the discovery of this process, the late Dr. CLARK,

Professor of Chemistry in the University of Aberdeen, conferred a valuable boon upon the inhabitants of hard-water districts. Dr. CLARK'S patent right has expired, and the public are, therefore, free to use this cheap and simple method of rendering hard water suitable for washing and cleansing purposes. The process is applicable to all water which owes hardness entirely or chiefly to the carbonates of lime and its magnesia (called *temporary hardness*).

The hard water derived from chalk, limestone, or oolite districts, is generally well adapted for it."

Again—

"Besides witnessing the operation on a large scale at Tring, Canterbury, and Caterham, we have made many trials on a smaller scale. Thus, for household purposes, the process may be carried out upon the water supplied by the Metropolitan Water Companies \* \* \* \* . Before softening, *Thames water* has generally a brownish yellow tint, when viewed in a cistern four or five feet deep (owing to the presence of coloured organic matter in solution), BUT AFTER BEING SOFTENED AND SETTLED, IT DISPLAYS THE BEAUTIFUL BLUE-GREEN TINT OF PURE WATER, AND RESEMBLES THE RHONE AS IT EMERGES FROM THE LAKE OF GENEVA!" \*

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\* See also pages 47 to 49.



### Objections and Difficulties hitherto experienced in applying the Softening Process.

Unfortunately, (and perhaps this is the reason it has not hitherto been more extensively adopted,) the original process presented some difficulties in its practical application, especially on a comparatively small scale, as for private mansions, schools, institutions, villages, and the like.

These difficulties were chiefly of two kinds:—

1. Dr. CLARK'S process pre-supposes a certain delay each time after the mixing is effected, during which the water has to stand in settling tanks for about twenty-four hours, for the precipitate to fall to the bottom. Hence, several days' supply must always be *stored*, and large settling and storage tanks become necessary, involving not only a large outlay at the beginning, but requiring so much space as to become neither convenient or economical.

2. Careful analysis of the water and many experiments are necessary before the conditions necessary to adapting the process in a given case can be determined, and these experiments can only be carried out by some one with a practical knowledge of the working of the process, and even then it is often a difficult problem. Hence frequent failures and dissatisfaction. When, however, the conditions are once accurately determined and estimated beforehand, the carrying of them out ought to be simple enough, and any ordinary labourer should be able to do it without difficulty.

### **Attempts to overcome these Difficulties by means of Filtration.**

Many attempts have been made by engineers and others to devise some means of doing away with the delay involved in the necessity of waiting so many hours after every lot of water has been softened, to allow time for the precipitate to fall to the bottom of the cistern in which it is treated.

Among many suggestions, the most promising would seem to be that of PASSING THE WATER THROUGH A FILTER, so as to FILTER OUT the precipitate instead of waiting for it to fall to the bottom of its own accord. And this is, undoubtedly, the true secret; but here another formidable difficulty arises, in the fact that the amount of this precipitate is, comparatively speaking, enormous. The quantity is, in fact, so great, as to choke any ordinary filter or filtering machine completely and hopelessly in a remarkably short space of time, and hence the attempts heretofore made to substitute filtration for precipitation have proved in practice to be but bungling expedients. The filtering machine gets constantly choked, and every time this occurs, the apparatus has to be taken to pieces, cleaned, and set up again, involving so much loss of time, annoyance, and trouble, that the old system of precipitation would seem to be preferable in the long run, as involving less trouble and greater certainty as regards an even, uninterrupted supply.

Besides, the filtering machines referred to are heavy, ponderous, expensive affairs, and for the first outlay run into



as much, or even more money, in many instances it seems to us, than the old system of settling tanks.

Still it has long been obvious that if a neat, comparatively cheap filter could be devised, which should not require pulling to pieces, and consequent long delay every time it gets choked, THEN the system of softening water by filtration would be incomparably superior to AND cheaper than any system at present known; and this great want is supplied by the machine described in the following pages, which answers perfectly to all the requirements of the case.

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### **Atkins's Improved System of Softening and Purifying Water by means of their New Patent Automatic Filter.**

In devising a filter for very bad water, or for filtering out the comparatively large amount of deposit which has to be dealt with in the process of water softening, we have to supply three paramount requirements—

1. The machine should be of such a nature, as to be capable of working equally well either under pressure, or in an ordinary open tank.
2. It must present the greatest possible amount of filtering surface within the smallest possible compass.
3. It should be so arranged, that while presenting A LARGE SURFACE, every square inch of such surface may be cleaned in the shortest possible space of time, and without the necessity of

pulling the machine to pieces, or of stopping the supply for more than a few minutes.

But, it may be said these are hard conditions to fulfil, and so they are. BUT THEY ARE COMPLETELY FULFILLED IN ATKINS & Co.'s PATENT AUTOMATIC FILTER, as will be seen by reference to the following description of the machine:—

The machine consists, in the first place, of a number of filtering discs, so arranged as to present the largest amount of filtering surface in the smallest compass. These discs are hollow, and are fitted on to a centre tube, which forms the main channel for carrying off the filtered water. This centre tube is made to revolve, *carrying the discs with it*. And running parallel to the surface of each disc is a small spiral brush, which, when set in motion, revolves rapidly, brushing all the time against the surface of the disc, and thus brushing away the sediment accumulated on it. But as the brush only touches one part of the disc at a time, all the discs are made to revolve by the same movement which sets the brushes in motion, and thus, in a few minutes, every square inch of the filtering surface of the whole machine has been brought in contact with a rapidly revolving brush, by which the whole filtering surface is cleaned and rendered free to go on filtering again. AND THE WHOLE OF THIS OPERATION IS EFFECTED BY SIMPLY TURNING A HANDLE OUTSIDE THE TANK OR IRON CASE, IN WHICH THE FILTER IS FIXED, AND WITHOUT OPENING SUCH TANK OR IRON CASE TO GET AT THE FILTER, AND WITHOUT STOPPING THE FLOW OF THE SUPPLY FOR MORE THAN A FEW MINUTES.



As an example of the advantage gained by this machine, let us suppose that one capable of supplying 25,000 gallons per day has become choked.

We simply turn a handle, and in less than five minutes the whole of the filtering surface is cleaned, and the machine goes on again as before, at the rate of 25,000 gallons per day.\*

The filtering discs are constructed in various ways, and of various materials, according to circumstances, and to the purposes for which they are required. Thus—

1. FOR WATER SOFTENING they are made of perforated metal, with filter cloth stretched over them; filter cloth being in most cases all that is necessary in this process to ensure the purest supplies, since all organic matter and other impurities are taken up by the lime, and thus rendered absolutely innocuous.†

2. For Water Works, and for manufactories where large quantities are required, the foregoing construction offers usually the greatest advantages, since it admits of being enlarged to any requisite extent, and in all cases it is the cheapest; considerably cheaper, for instance, than sand and gravel beds, or other rough straining contrivances, and far more easy and economical to clean.

3. The discs may be constructed of porous earthenware, OR CARBONIZED POROUS EARTHENWARE;‡ they may also be filled with animal charcoal or other filtering substance, and may be arranged in many other ways.

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\* The deposit brushed off the filter is carried off through the waste pipe. (See page 38.)

† Sometimes, if the nature of the water appears to warrant it, the softened water may be afterwards passed through an inexpensive filter bed of suitable material.

‡ A new process patented by Messrs. ATKINS & Co.

4. Where the impurity in the water is of such a character that brushes may appear inadequate to remove it from the surfaces of the discs, the patent provides for metal scrapers, &c., to remove the deposit.

5. For manufacturers desirous either to stop incrustations in boilers, or to prevent the flow of foul waste water into streams, the machine can be arranged in a variety of ways to meet special circumstances.

6. To Railway Companies suffering loss from the furring of locomotive boilers, the cost of its adoption ought to be repaid within a year or two by the economy it effects.

7. For Steamboat Companies whose vessels ply upon muddy rivers as well as for Steam Shipping Companies of all kinds, this arrangement can be carried out in a very small space and in such a way as to effect great economies, whilst reducing the trouble of working and the risk of explosions.

8. For clearing muddy water generally, for whatever purpose the machine can be used, either in conjunction with the lime process OR WITHOUT IT. Used in the latter way, simply as a strainer or rough filter to *clear* large quantities of dirty water, it is cheap as to first cost, and extremely economical in after working. In this case some variations are advisable in its application suitable to the special circumstances of each particular case.

9. In the case of water containing much organic matter, arrangements can be made for aerating the filter as frequently as may be deemed necessary.



### Explanation of the Automatic Filter.

A reference to the accompanying illustrations will explain more clearly the construction and working of the Patent Automatic Filter, used in carrying out ATKINS & Co.'s system of softening and purifying water supplies.

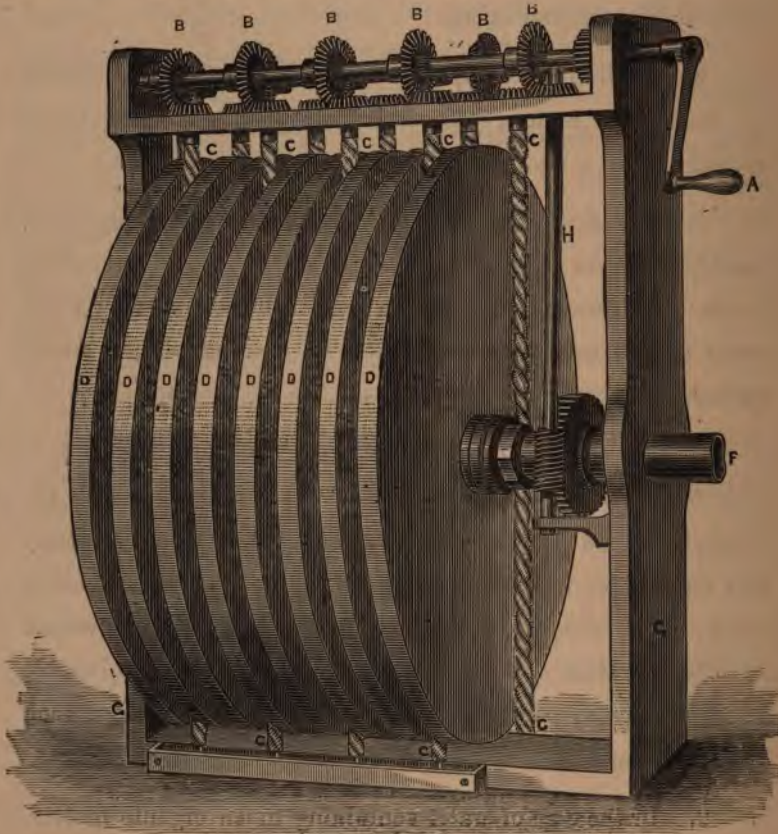


FIG. 201.

Fig. 201 represents the machine apart from the tank or high pressure case in which it is subsequently fitted.

The filtering discs are shown at D D D D D. These are supposed to be either hollow metal covered with filter cloth, or hollow discs of porous earthenware, or porous charcoal, as before described.

This arrangement of discs gives the greatest possible amount of filtering surface within the smallest possible compass.

The filtered water collects *inside* these discs, and is carried away through the outlet of the centre tube, F.

To clean the surfaces of the filtering discs we turn the handle, A, this turns the cog wheels, B B B B B, which set the brushes, C C C C C, rapidly revolving each on its own axis against the surfaces of the discs, D D D D D. But the handle, A, also communicates motion to the discs themselves, through the rod, H, which by means of a worm causes the discs to revolve slowly and bring every portion of their surfaces by degrees in contact with the rapidly revolving brushes.

Thus, by the time that the discs have completed *one* revolution (requiring only a few seconds), every portion of their surfaces has been brought under the action of the revolving brushes, and has been brushed clean. The whole filtering machine is then clean, and ready to be set to work again without the unscrewing of a single bolt, and without interrupting the supply for more than a few minutes.

FIG. 204 shows the case in which the machine may be enclosed to work under pressure. The handle, A, being outside, the filter can be cleaned forty times a day, if necessary, without disconnecting a single pipe or joint.



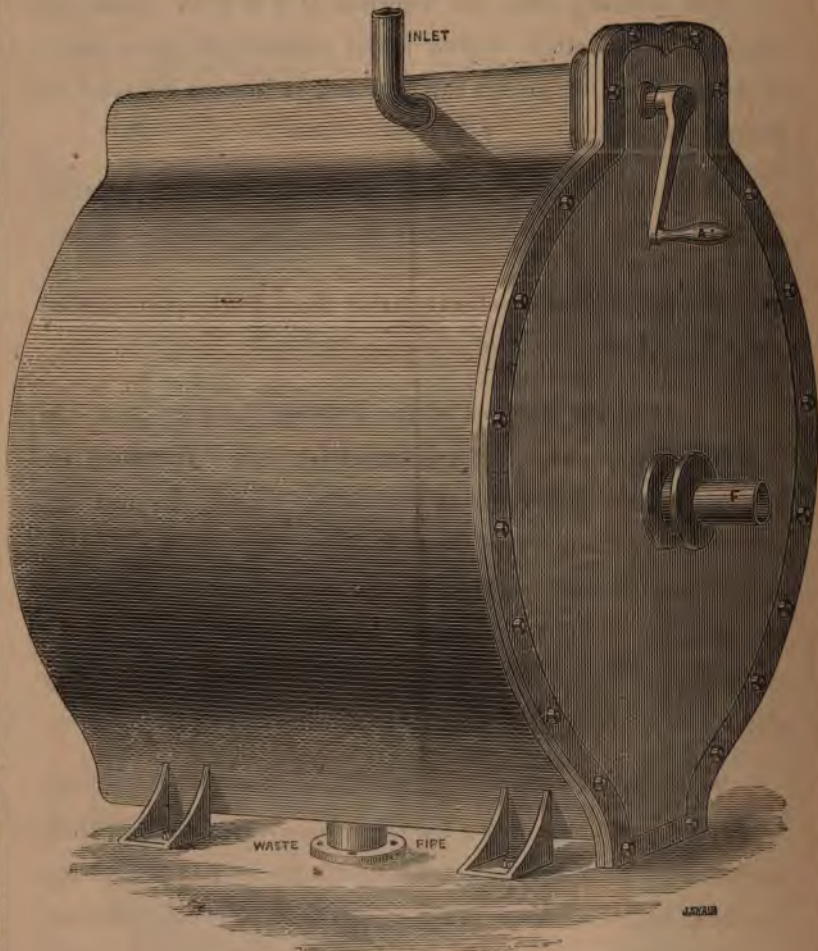


FIG. 204.

In this method of fixing, the face of the enclosing case is made to take off by means of the nuts shown, to take out the filter for the purpose of renewing the filter cloth or other filtering material. This, of course, is necessary occasionally, but only at long intervals.

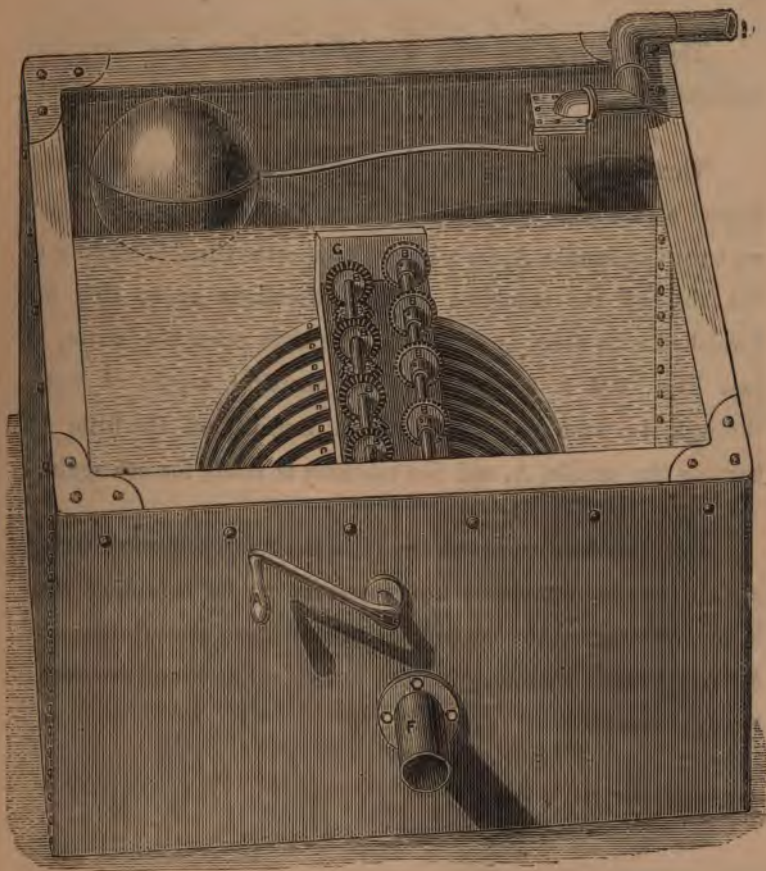


FIG. 207.

Fig. 207 shows the Filter fitted in an open tank, which is convenient under some circumstances.

The handle, A, a few turns of which cleans the whole surface of the Filter, is still outside, as in the former case; and all the other arrangements are the same.

### Cleaning.

The cleaning, as will be inferred from the foregoing explanations, is of the simplest possible character.

Thus, we first stop the flow of water by a tap or valve, placed somewhere near the outlet for filtered water, F. Then we turn the handle, A, for a longer or shorter time, according to the size of the machine. (Full directions as to this are furnished with every apparatus.) We then open the waste, W (see Figs. 204 & 207), and run a plentiful supply of water through, to wash out the sediment brushed off the filter by turning the handle, A, and the machine is ready for use again.

But in those cases where it is used for softening water, certain special directions are necessary to be complied with before turning on the supply again, and these are furnished by Messrs. ATKINS separately in each individual case, and according to requirements.



## The Application of the Atkins's Improved Patent System to Private Residences, Schools, Public Institutions, Asylums, &c.

The comforts and advantages which the adoption of a pure soft water supply for large or moderate-sized country houses and other establishments confers upon the inmates we have already alluded to. It only, therefore, remains to speak of the conditions necessary for carrying out the improved system of water softening, in order to ensure the successful results desired.

1. The kinds of water most suitable for the process, *Kinds of water to which the process may be applied.* and with which the most perfect results are attained, are those which contain a large proportion of *carbonate* of lime, *Waters containing much carbonate of lime.* and only a small proportion of *sulphate* of lime. With such a water *no matter what its impurity may be in other respects,* Messrs. ATKINS & Co.'s system is always applicable, and may be relied upon to produce the most perfect and beautiful results.

2. Even where the *carbonate* of lime is SMALL in quantity, or the *sulphate* LARGE proportionately, and thus *Waters which contain less carbonate.* the softened water, though reduced in hardness, is not so soft as in the former case, the process is still applicable, and its adoption is certain to prove beneficial and satisfactory, on account of the fact that it removes the organic matter and other dangerous or disagreeable impurities, and renders the whole supply sweet and wholesome.



As regards these points, however, an approximate estimate can only be formed after an examination of the water to be treated, calculated according to the quantity required, and the price of lime delivered on the spot.

*Cost of  
renewing  
filter and  
apparatus.*

7. There remains the cost of keeping the filtering apparatus in working order. This is extremely small. The filtering cloth or other filtering material has to be renewed at intervals at a small cost, and the usual attendant on the apparatus can do this. All the other parts of the apparatus are strong and well made, and with ordinary attention and care will wear well for years.

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### **Economy in Asylums, Colleges, Schools, Public Institutions, &c.**

In all large establishments where the washing, cooking, bread-making, &c., are, for the sake of economy or convenience, carried on on the premises, the saving in money, time, labour, and temper, effected by the introduction of this system, are so great as to be placed beyond all dispute.

In all matters connected with washing, whether in the laundry, or as regards the washing of floors, or in bathing and personal ablution, the effect of hard water is most unmistakable and most wasteful. Not only is the amount of soap used three or four times as much as is necessary, but as a matter of fact the required effects *cannot* be produced. The linen *cannot* be properly washed, nor can it be rendered a good colour; floors, &c., *cannot* be properly cleaned, nor can the hands, face or body be kept properly washed.

Thus, in going over such establishments, we have noticed in some cases—particularly in rooms set apart for eating purposes—a peculiar faint, disagreeable, sickly smell. On enquiry, it appeared that from time to time bits of meat, fat, butter, &c., are dropped by the children or other inmates, and get trodden into the boards. Now, if soft water were used with plenty of soap, this would be easily kept clean. But owing to the hardness of the water no amount of soap seems to produce any lather, and hence the grease, &c., *cannot* be washed off, but *is left to putrefy*, and in time the whole room becomes impregnated with the sickly odour referred to.

Much the same thing occurs in the dormitories and bedrooms. Indeed, we really cannot see how a place of the kind can be kept clean with very hard water; nor can we understand how the managers of such places can continue to put up with the state of uncleanness which is the inevitable result.

As regards economy in the prevention of furring in pipes and boilers, and in making tea and cooking, we have quoted opinions and evidence already. But we will give in addition an instance that occurred under our own observation at the Royal Army Clothing Dépôt, Pimlico. At this place they employ many hundreds of women, and as these have some of their meals on the premises, a roomy kitchen, with large boilers and other cooking arrangements is kept up for their service.

Every afternoon tea is provided for the whole number, and the late Superintendent, COL. HUDSON, took a kindly



personal interest in ensuring that everything supplied should be wholesome, and of the best quality of its kind; but the water used was of such a kind that the pipes and boiler got completely choked *twice a year*, and had to be taken to pieces and heated red hot before the incrustation could be removed; while the amount of tea used was far beyond what it ought to have been.

After, however, we had carried out a system of water purification, all these evils were thoroughly obviated. The pipes and boilers were never choked up\*; while the tea was not only better in quality, *but was made with scarcely more than one-half the quantity of tea formerly measured out*, though the quality of the tea bought was the same. And, as some hundreds of gallons of tea are made every day, it will be readily understood what an economy has resulted in this alone, to say nothing of the saving resulting from the pipes and boilers no longer getting choked up.

This apparatus was fixed in 1868, and has continued at work ever since, now 11 years, during which time it has been kept in order at a charge of two or three pounds a year only.

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\* See Col. Hunson's letter, page 67.

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## Treatment of the Water Furnished by the London Water Companies.

The Water supplied by the London Water Companies is particularly well adapted for treatment by the softening process—for though very hard as delivered to consumers, yet the hardness being principally what is called “temporary,” it is all but completely removed by proper treatment, and the water then becomes not only soft but pure, and shows the beautiful blue tint already spoken of, *the natural colour of pure water*.

These Water Works Companies supply a very large area outside London proper, and thus a great number of large establishments and private mansions both in town, and a few miles out, draw their water supply from one or other of them.

It may be worth while, therefore, to give a few particulars respecting these waters, with notes showing exactly what results may be attained in carrying out the softening system with such supplies.

That very considerable inconvenience, annoyance, trouble, and loss are suffered by consumers owing to the hardness of these waters, it is scarcely necessary to assert; nor need we dwell here upon their impurity, and the consequent dangers to health; for these must also by this time be well known to all dwellers within the Metropolitan district. Suffice it to say, that all the best authorities unite in condemning them all as quite unfit, without purification, for any domestic purposes, whether drinking, cooking, or washing.

The following example is one, among many, that we might quote:—

*From the "PAUL MALL GAZETTE," February 24th, 1879.*

" \* \* \* Some idea may be formed of the comparative value of the London waters as remedial agents by simply studying the deposits they leave in the cisterns and pipes, which are occasionally of a marked character. For instance, at the meeting of the Woolwich Board of Guardians last week, the Infirmary Committee reported that the hot-water pipes connected with the matron's kitchen had become entirely choked up with lime deposited from the Kent company's water. The pipes, an inch in diameter, were exhibited in the Board Room and found to be full of solid lime. It was stated that they had only been in use nine months. The Board decided on asking the Company to "suggest a remedy;" but the water thus impregnated with lime may perhaps itself be a valuable remedy for some of the diseases treated in the infirmary. There are lime compounds highly prized as curative agents by the medical profession."

The adoption of the improved softening system not only obviates completely all such difficulties and troubles as the above, but safeguards the health of all the inmates of a household at the same time, by turning the nasty, foul, impure mess furnished by the London Companies, into a brilliant, soft, sweet and wholesome supply.

The Royal Commissioners give some notes of their experiments in this direction upon the Water supplied by (1) The Grand Junction Company, (2) The New River Company, and (3) The Kent Company. They say:—



“ We have in this way experimented upon the water of the Thames as delivered in London by the Grand Junction Company, upon that of the Lea as delivered by the New River Company, and upon the water from deep wells in the chalk as supplied to Metropolitan consumers by the Kent Water Company. The following analytical table shows the chemical composition of these waters BEFORE AND AFTER THE SOFTENING OPERATION :—

COMPOSITION OF METROPOLITAN WATERS BEFORE AND AFTER SOFTENING.

Name of Company.	Total solid Impurity.	Organic Carbon.	Organic Nitrogen.	Hardness.
Grand Junction Company, 8th Feb., 1871 .. .. .	31·70	·241	·040	21·2
Ditto, after softening.. .. .	16·58	·178	·021	7·0
Grand Junction Company, 1st June, 1870 .. .. .	23·98	·144	·018	18·8
Ditto, after softening.. .. .	9·26	—	—	3·8
LEA WATER.				
New River Company, 14th Feb., 1871 .. .. .	30·60	·135	·018	22·4
Ditto, after softening.. .. .	13·76	·100	·011	6·0
WATER FROM DEEP WELLS IN THE CHALK.				
Kent Company, 16th Jan., 1871 .. .. .	40·42	·045	·014	29·1
Ditto, after softening.. .. .	19·00	·044	·010	7·0

“ It will be seen from the above table that the softening method is equally efficacious for softening all three kinds of water ; indeed, the water of the Thames and Lea is chiefly chalk spring water similar to that delivered by the Kent Company, *but soiled by filthy impurities.* Besides *softening* the Thames and Lea Water, however, the treatment with lime also removes from them a considerable proportion of impurities, as is seen by an inspection of the columns headed Organic Carbon, and Organic Nitrogen in the above table. The results would in this respect have been still better had not the conditions of the



experiments upon the Thames water necessitated the exposure of the softened water in a cistern on the roof of a house to all the impurities of a London atmosphere for twenty-four hours."

The following table shows the hardness of the water supplied by the different London Companies, as compared with the water supply of Birmingham and Glasgow, taken from the Registrar-General's Reports, 1879 :

RESULTS OF ANALYSES EXPRESSED IN PARTS PER 100,000.

	COMPANIES OR LOCAL AUTHORITIES.	Date and Place of Collection.	Temperature in centigrade degrees.		Total Solid Mat- ters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Ni- trates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.
Inner Circle.	THAMES :											
	Chelsea - -	Cab Rank, Horse Guards.	4.3	30.30	.188	.038	.004	.150	.193	1.6	19.7	
	West Middlesex -	Cab Rank, Portland-road.	2.8	28.92	.441	.042	0	.214	.256	1.5	18.8	
	Southwark - -	{ Cab Rank, St. George's Church, Borough. }	2.3	33.40	.269	.040	0	.183	.223	1.5	22.4	
	Grand Junction -	Lancaster-gate, Hyde Park.	2.3	28.68	.408	.053	0	.201	.254	1.5	18.6	
Outer Circle.	Lambeth - -	{ Cab Rank, Westminster Bridge-road. }	1.3	34.54	.234	.043	0	.314	.337	1.6	23.6	
	OTHER SOURCES :											
	New River - -	{ Cab Rank, Tottenham- court-road. }	1.8	31.86	.221	.040	0	.307	.347	1.5	21.6	
	East London -	Royal Hotel, Mile-End-rd.	0.8	35.87	.220	.042	.008	.306	.354	1.7	24.8	
	Kent - - -	{ Deptford Bridge Police Station. }	11.3	45.62	.085	.016	0	.420	.436	2.4	20.4	
	Colne Valley -	Bushey.	4.9	13.16	.063	.017	.003	.339	.358	1.4	4.0	
	Tottenham Local Board - - -	{ High-street, Tottenham. }	-	48.86	.049	.017	0	.549	.566	3.3	35.0	
	Corporation of Birming- ham - - -	{ 15 and 16, Mill-lane. }	2.8	24.24	.187	.058	.007	.275	.339	1.6	13.9	
	Corporation of Glasgow	Loch Katrine service.	2.8	3.00	.152	.011	0	.007	.018	.60	1.43	

The "Colne Valley" supply referred to in this table is the water furnished by the works near Watford, to which we have alluded (see page 9) as one of the places near London at which the water-softening system is carried out, and where the water, as seen in the tanks, displays the beautiful blue-green tint, the natural colour of pure water.\* The softness and general purity of this water, as compared with the general London supplies, are too obvious to need comment or any explanation of the table.

It will be seen that all the water of the different London Companies is very hard, the Kent Company supplying the hardest of all.

It is no wonder the Royal Commissioners remark, "It is a misfortune that a large metropolis like this is supplied with water so hard."

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\* "Beautiful blue-green tint, the natural colour of pure water." As this expression occurs more than once, it may be as well to explain that *pure* water is *not* colourless, as is popularly supposed (except when seen in a very small quantity, as in a tumbler, where the quantity is too small for the colour to be apparent), but of a beautiful bluish-green tint. It is true this colour is seldom or never seen in England, unless in the case of supplies chemically purified—as, for instance, by this process—but it is commonly seen in the mountain streams and upper lakes and tarns of the Alps and other mountainous districts, and the Rhone, as it leaves the Lake of Geneva, is a notable instance of it. In connection with this we may mention a circumstance that occurred a few years ago in the country, at a place where we had just carried out our system of purification for a private establishment. The purified water lying in the tanks exhibited this beautiful tint, but our clients were so puzzled and surprised by its appearance that they were afraid at first to drink it, believing there must be something wrong! This serves to illustrate our remark (page 8) that comparatively few people have any adequate idea what pure water is really like.



**EXAMPLE I.****Illustration of a Water-softening and Purifying Apparatus suitable for a Country Residence.**

*Taken from an Apparatus designed and carried out for the Earl of Essex, at Cassiobury Park, near Watford, Herts.*

The illustration (Fig. 220) shows a Water-softening Apparatus complete under the new system, suitable for a country mansion. This arrangement is calculated for the treatment of from 3,000 to 5,000 gallons of water a day.

The Apparatus fixed, complete, includes the following :—

1. A tank to store the mixture of lime-water.
2. Two tanks, one containing a reserve of water to be treated, and the other a graduated amount of the lime-water to be mixed with it.
3. The mixing chamber, in which the two streams are made to meet in certain proportions and, by means of a peculiar arrangement, are made to flow backwards and forwards during a certain period to ensure their becoming thoroughly inter-mixed.
4. The ATKINS'S Automatic Filter, which receives the stream as it flows from the above arrangement of tanks and delivers it to the storage tank shown at the bottom of the drawing.

**This Apparatus supplies 1½-inch pipe.**



5. All necessary ball-cocks, valves, &c., for connecting the tanks and filter.

The engraving shows all the foregoing supported on the side of a wall, and explains of itself the working of the apparatus.

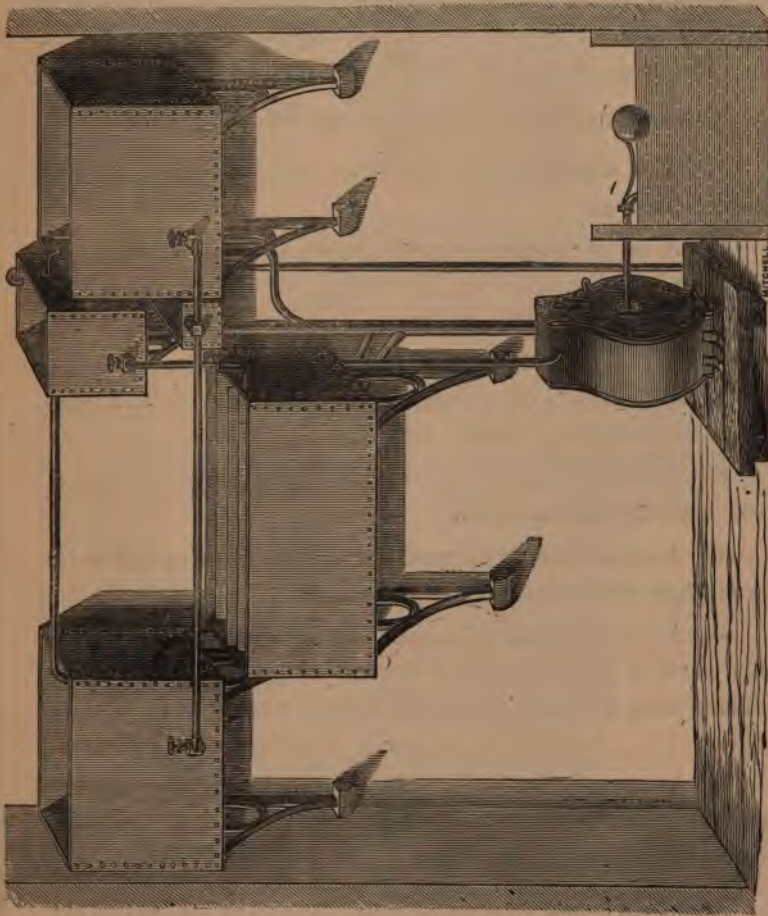


Fig. 220.

## EXAMPLE II.

FIG. 224.

**Illustration of a scheme of Water Supply and Water Softening, suitable for a large Country Residence or other Establishment.**

*Similar to a scheme of Water Supply and Water Softening carried out for H. G. THE DUKE OF RICHMOND AND GORDON, K.G., by Messrs. Atkins & Co., in conjunction with Messrs. Waller & Sons, Lyall Street, Pimlico, London, S.W.*

This scheme, complete, includes the following, viz. :—

1. The sinking of a well (if no available well should be already existing).
2. A set of pumps to raise the water to the surface, and to deliver it to the softening apparatus.
3. A complete Water-softening Apparatus on a larger scale than the foregoing (page 51), with the necessary tanks, valves, &c., capable of supplying all the wants of the establishment, including laundry, &c., &c.
4. An engine and boiler to work the pumps, with engine-house and appropriate sheds.
5. A set of pumps to raise the supply of pure soft water to a storage reservoir through a 4-inch main.
6. A storage reservoir, built on high ground, if practicable, so as to form not only a storage of pure soft water for ordinary uses, but, in addition, a reserve available in case of fire, &c.
7. An arrangement of supply pipes and hydrants running round the mansion, and available either for watering the lawns and flower beds, cleaning the windows, or in case of fire.

The whole arrangement is adapted to raising and softening 2,000 gallons an hour.



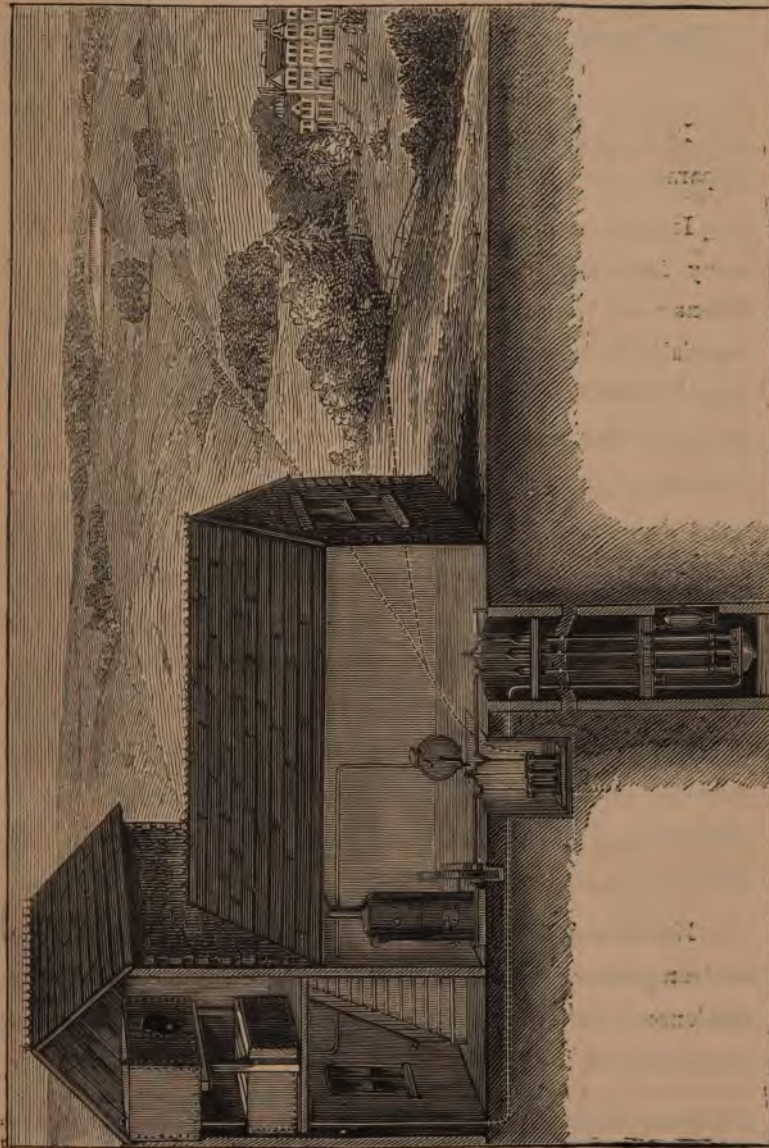


FIG. 224.



## The Treatment of the Water Supply of Country Residences by Filtration.\*

In the following pages we give a few examples of Filtering Apparatus, designed and carried out for Country Residences.

It will be observed that these differ from each other in many important details, and were we to give examples of dozens more, the same remark would apply, since each has been especially designed for the particular place, and with strict regard to the nature of the water, and the surrounding circumstances of each case.

These examples are taken from the original drawings made by us at the time of the execution of the work. We could multiply such examples to almost any extent if desirable, and our space would allow of it; but we give sufficient here to illustrate the principles by which we are always guided in advising on questions of domestic water supply.

In this branch of sanitary engineering we have had indeed long and exceptional experience, and can affirm, that we have designed and carried out more work of this kind than any other firm in the country.

Hardly any firms of engineers interest themselves much in the comparatively small questions of these supplies to private residences; while on the other hand the *filter-makers* are *not* engineers, and their attempts to interfere in questions of water

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\* The treatment of water supply by filtration does not require regular attention, as is the case with the Water-softening Apparatus, and is, therefore, frequently preferred for that reason. The action of our system of filtration as regards softening is considerable, though of course not equal to the softening process. (See Reports, page 68.)

supply in any way larger than is represented by the sale of earthenware filters naturally end in bungling and disaster.

Our own experience in practical engineering is shown by the works we have designed and carried out for towns in various parts of the country\* (both before and since our first connection with filters), and is sufficient, we trust, to confirm our statement that we can bring to bear upon the subject of sanitary water supply special and exceptional practical experience.

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### Of the Materials used in Filtration.

The variety exhibited in the characteristics of samples of water drawn from various sources would be remarkable, if we were to leave out of sight the multitude of ever-varying causes upon which they depend; but, bearing this in mind, it is not strange to find that amongst a large number of samples no two can be picked out which exactly resemble each other; and, indeed, to go further, when we consider how infinite are the combinations possible, the wonder would be ever to find two kinds exactly alike.

If water drawn from the same tap—as, for instance, a tap from an ordinary London cistern—will vary to an appreciable extent from one hour to another (and this is the case), it is not surprising that samples of water drawn in various parts of the United Kingdom, should exhibit very great difference indeed.

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\* They include water works, or gas works, &c., for the supply of the following towns, viz.:—Great Berkhamstead, Hemel Hempstead, Sheerness, Dartmouth, Harrow, Brimscombe, Chipstow, Milford Haven, Aberavon, Sheepshead, Keynsham, Welwyn, and many others.



This being so, we must be guided in our selection of the materials to be used for the filtration of a given sample of water by the peculiarities of that particular sample; and since water varies so greatly in character so should our treatment vary, and in like manner the materials employed and the combinations of those materials.

The materials used in these examples consist principally of arrangements of patent cistern filters, in combination with "rough-filtering" tanks. The latter are to partially cleanse the water of the mud or sediment and the chief of the coarser impurities, in order that the cistern filters, constructed with charcoal blocks of very fine porosity, may not get choked too frequently.

In all cases, ample provision is made for facility of cleaning from time to time.

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### EXAMPLES.

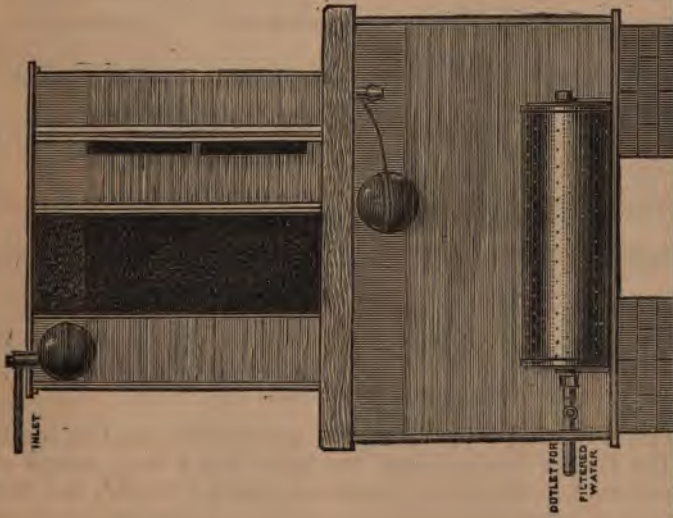
Fig. 240.

Compound Filtering Apparatus, designed for His Grace the Duke of Marlborough, for Blenheim Palace, Woodstock, near Oxford, in November, 1874.

The water being of bad quality, ample surface and room are necessary. In the upper tank the water undergoes two distinct filtrations, and afterwards passes into the lower tank, where it undergoes a final filtration through a set of patent cistern filters.

See Extracts from Testimonials, page 64.





(ELEVATION.)



(PLAN.)

FIG. 240.  
Compound Filtering Apparatus fixed at Blenheim Palace, Woodstock, near Oxford.

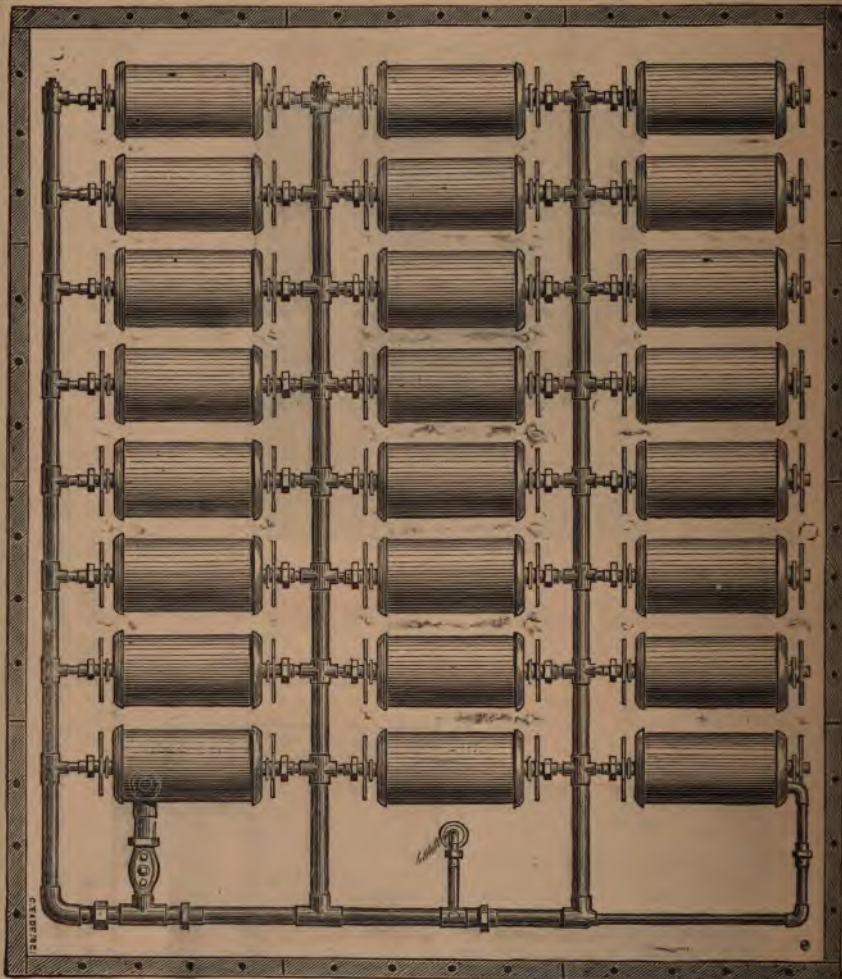
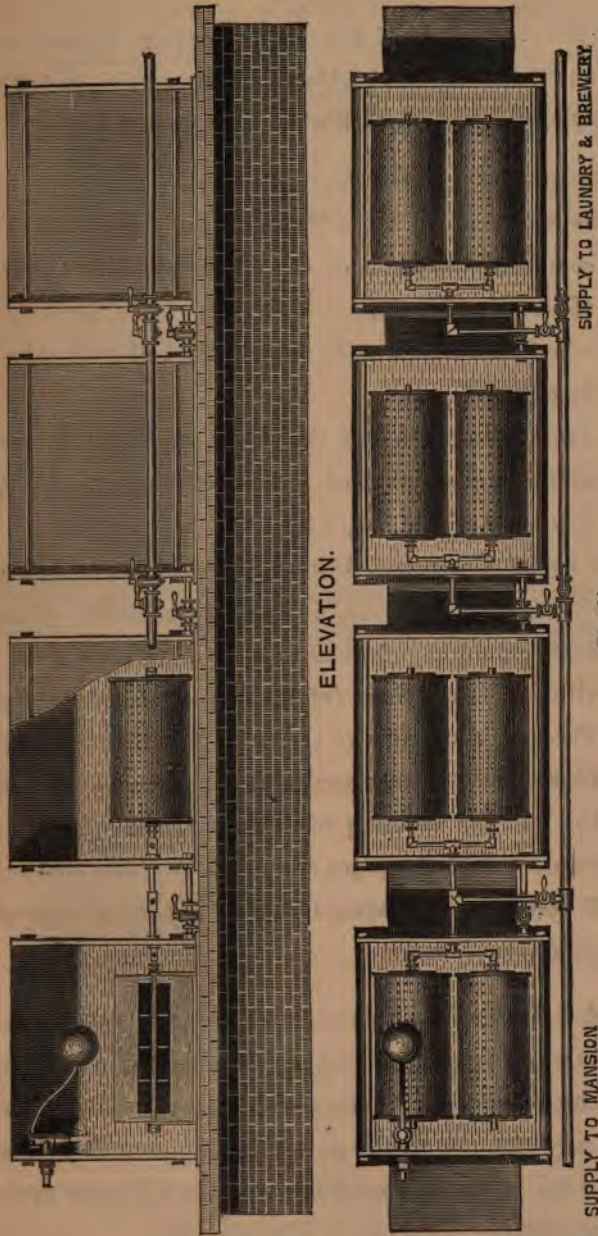


FIG. 29 (PLAN).

The above plate (Fig. 29) represents one of the many large Sets of Apparatus supplied by Messrs. ATKINS and Co. for various purposes in England and abroad.

This Filtering Apparatus was constructed for the Right Hon. the Earl of Durham, and was fitted into a large cistern at his Lordship's Residence at Lambton Castle, Durham, in 1868. It consists of twenty-four Filters so connected together as to form one large filter. (See Extracts from Testimonials, page 64.)



PLAN.  
FIG. 247.

Filtering Apparatus, consisting of Slate Tanks and sets of Patent Cistern Filters, designed for Lord Aveland, and fixed at his Lordship's Residence at Normanton Park, April, 1874. (See Extracts from Testimonials, page 65.)



Fig. 32 shows a System of Sanitary Water Supply, designed and carried out at Newmarket, by Messrs. ATKINS & Co., in 1873, for the supply of Captain Machell's Training Establishment.

The arrangement includes the following :—

1. The erection of a Water Tower of sufficient height to command the whole of the premises, including the House, Stables, &c.
2. A set of improved Pumps fixed in the well and worked by a pony.
3. A large storage Tank at the top of the Water Tower, containing a sufficient reserve of water to be of service in case of fire, &c.
4. A Patent Compound Filtering Apparatus, as before described, placed in a separate chamber where access can always be had to it for cleaning, &c.
5. Galvanized iron pipes (of 2" bore), carried from the Filtering Apparatus to the main pipe supplying the house, and to large cocks (also 2" bore), placed in the yard for watering the horses. In this arrangement, though the pipes and cocks are (as stated) of 2" bore, yet they always run off a *full stream* of pure filtered water.

The Water Tower is, of course, made to serve other purposes besides that of holding the tanks. The bottom serves for a carriage house, and the first story as a storage chamber for fodder, &c., only the two upper stories being occupied by the tanks and filters. (See Extract from Analytical Report upon the above, page 68.)

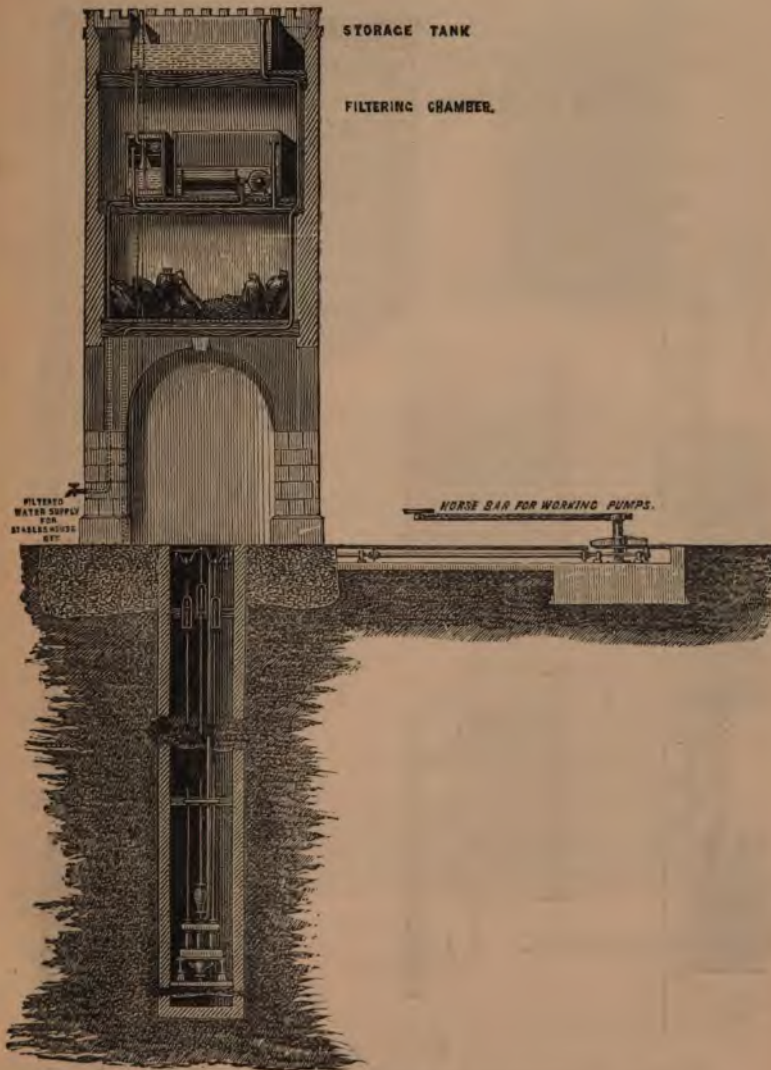


FIG. 32.

Sectional view of Water Tower, with well beneath, showing arrangement of Pumps, Filters, &c.

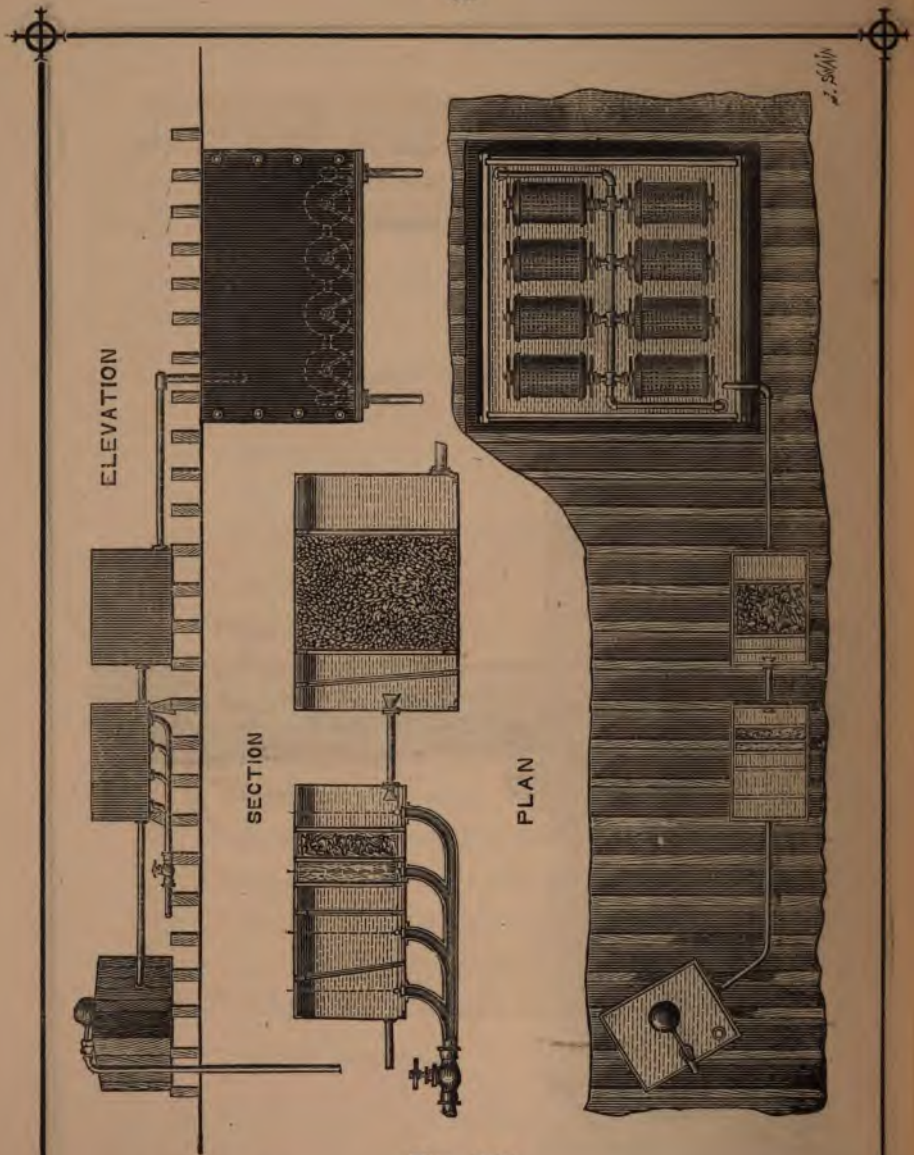


FIG. 255.

Filtering Apparatus specially designed for Longmead, the Residence of A. Barton, Esq., in September, 1871. The water is extremely thick from the quantity of impurity, chiefly iron in suspension, and constantly choked up the pipes and boiler.

The Apparatus consists of suitable filter tanks combined with a set of patent cistern Filters. (See Extracts from Testimonials, page 69.)



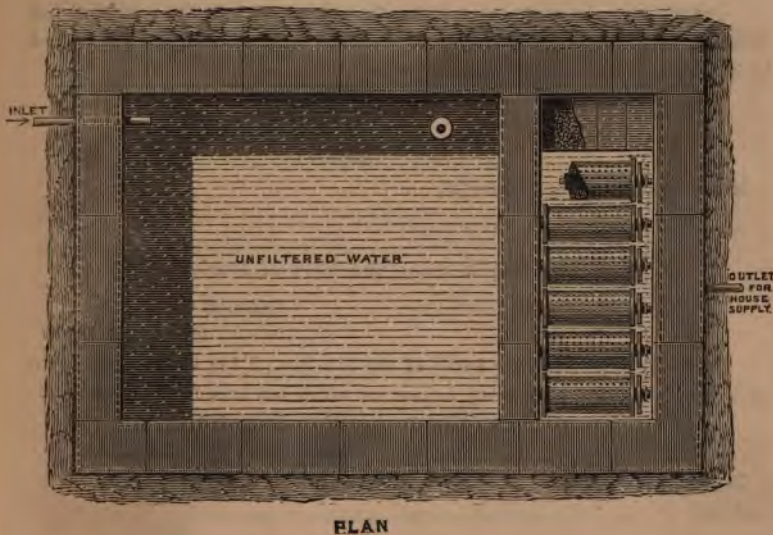
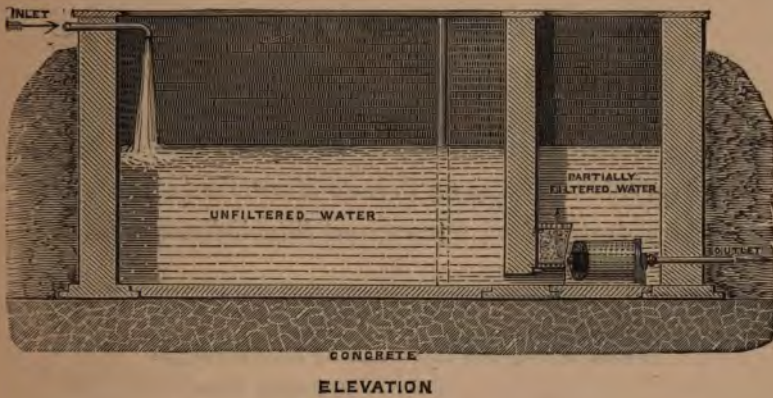


FIG. 258.

Filtering Apparatus designed for Abbotsfield, Wiveliscombe (Somerset), the Residence of C. L. Collard, Esq.

The water contains much iron and clay, and, before the Apparatus was fixed, constantly choked up the pipes, &c. (See Extracts from Testimonials, page 69.)

## Atkins's System of Water Supply.

*We subjoin Extracts from a few Testimonials referring to work carried out by us at Private Mansions in Town and Country, Institutions, Government Establishments, &c.*

From His Grace the Duke of Marlborough.

BLENHEIM, OXON,

November 27th, 1873.

GENTLEMEN,—In reply to your application as regards the merits of the Filtering Apparatus supplied by you to the Duke of Marlborough, I am desired by his Grace to state that it answers very well.

I am, GENTLEMEN,

Your obedient Servant,

(Signed) S. ECCLES.

Messrs. ATKINS & Co., Engineers.

From the Right Hon. the Earl of Durham.

LAMBTON CASTLE,

March 21st, 1872.

SIRS,—In answer to your letter of the 8th inst., I beg to say that I am quite satisfied with the Filtering Apparatus which you have fixed for me here.

Yours faithfully,

(Signed) DURHAM.

F. H. ATKINS & Co.

From the Right Hon. the Earl of Antrim.

GLENARN CASTLE,

LARNE, N. IRELAND,

March 1st, 1867.

GENTLEMEN,—In reply to your letter of the 27th ult., I have much pleasure in stating that the Apparatus fitted by your firm in 1865 has given great satisfaction, and I consider it all that could be desired.

Yours,

(Signed) ANTRIM.

Messrs. F. H. ATKINS & Co., Engineers.

**From Lord Aveland.**

*August 2nd, 1876.*

Messrs. ATKINS & Co. have carried out their system of Sanitary Water Supply at my three houses, Normanton Park, Bulby Hall, and 12, Belgrave Square, and I have much pleasure in stating that their plan has given me every satisfaction.

(Signed) AVELAND.

**From the Right Hon. Lord Edward Spencer Churchill.**

24, MANCHESTER SQUARE,

*August 11th, 1878.*

LORD EDWARD SPENCER CHURCHILL begs to acknowledge the receipt of Messrs. ATKINS's letter, and in reply to state that he is very well pleased with the Cistern Filters which they fitted up for him—they work very well and give general satisfaction.

**From the Right Hon. Lord Radnor.**

LONGFORD CASTLE, SALISBURY,

*August 14th, 1878.*

SIRS,—In answer to your communication received this morning, I beg to state that the arrangement carried out for me has given every satisfaction.

Your obedient Servant,  
(Signed) RADNOR.

Messrs. ATKINS & Co., Engineers.

**From S., Lady Milton.**

ARMFIELD, HADDINGTON,

*August 10th, 1878.*

S., LADY MILTON begs to inform Messrs. ATKINS & Co. that the Patent Cistern Filters answer perfectly.

**From the Right Hon. Lord Ashley.**

29, CHESTER SQUARE,

*October 1st, 1878.*

LORD ASHLEY has had several years' experience of F. H. ATKINS & Co.'s Patent Cistern Filters, and has every reason to be perfectly satisfied with their efficiency. He considers them simple in their fittings, easily cleaned, and very durable, and will certainly take every opportunity of recommending them to other householders.



**From Count Batthyany.**

*August 14th, 1878.*

COUNT BATTHYANY presents his compliments to Messrs. F. H. ATKINS & Co., and begs to state, in reply to their enquiries respecting the Cistern Filter supplied to him, that he is in every way perfectly satisfied with it, and can strongly recommend it.

**From Sir T. Frederick Elliott, Bart., K.C.G.**

7, ONSLOW SQUARE,

*September 30th, 1878.*

GENTLEMEN,—Five years ago your Patent Filter was fixed in my cistern, and has worked quite satisfactorily, and I have no doubt of the value of such an appliance for ensuring the filtering of all the water used in the house for drinking or cooking purposes.

Your obedient Servant,

T. FREDERICK ELLIOTT.

Messrs. F. H. ATKINS & Co., Engineers.

**From Sir Hugh Cholmely, Bart.**

10, UPPER BELGRAVE STREET, S.W.

*August 4th, 1878.*

SIRS,—In reply to your letter I have much pleasure in informing you that the patent Cistern Filter you put up in my house has given great satisfaction.

I remain your obedient Servant,

(Signed)

HUGH CHOLMEY.

Messrs. F. H. ATKINS & Co., Engineers.

**The Ashantee War.—Certificates from the War Office, Pall Mall.**

The Filters supplied by F. H. ATKINS & Co., 62, Fleet Street, for the use of the Troops during the Ashantee Campaign, answered their purpose admirably.

I had them in constant use for six weeks or two months, and can testify that I found them most useful, and well adapted for the service.

(Signed) M. B. IRVINE, C.B., C.M.G., Deputy-Controller.

*February 1st, 1875.*

I can fully corroborate this certificate.

(Signed)

G. WOLSELEY, Major-General.

*February 1st, 1875.*

Your Filters in Ashantee were excellent.

COLONEL GREAVES, Chief of the Staff in the Ashantee War.

### Royal Army Clothing Factory, Pimlico.

March 14th, 1871.

GENTLEMEN,—In reply to your enquiry respecting the efficient working of the Apparatus put up by you some three years since in the Government Factory, Pimlico, I beg to inform you it has proved a very great success.

The difficulty we had to contend with, prior to its adoption, in using the water furnished by the London companies, as well as that pumped from wells, was, that all supplies, though apparently perfectly clear when cold, nevertheless contained a large amount of deposit, and became turbid when at the boiling point, and rapidly formed incrustation in the boilers and supply pipes of the establishment. To such an extent was this incrustation deposited that it frequently became necessary to scale the boilers, and to take down the pipes for the purpose of removing the incrustation, and constant expense and trouble was incurred in so doing. This occurred every six months, and on each occasion the pipes were found to be so stopped up that a pencil could not have been passed through them, and it was necessary to heat them red hot before the deposit could be removed.

The Apparatus fitted up by you has effectually remedied this difficulty. After using the filtered water for eighteen months, the pipes and boiler were examined and found to be perfectly free from any deposit, and the boiling water at all times remained perfectly clear and remarkably sweet. It has continued so ever since. With regard to the cost of the Apparatus, I consider that the expense of putting them up and of cleansing and keeping them in order has been far more than covered by the absence of outlay in taking down and replacing the pipes and scaling the boiler; and setting aside the advantages, from a sanitary point of view, of having pure and sweet water on all occasions for the use of the establishment, I consider the system of filtration you have carried out to be a very great economy.

I am, GENTLEMEN, Your obedient Servant,

JOSEPH HUDSON,

*Lt.-Col. and Superintendent Royal Clothing Factory.*

MESSRS. ATKINS & Co., Engineers, Fleet Street, E.C.

### Baroness Burdett Coutts' Model Lodging Houses, Columbia Square.

The REGISTRAR-GENERAL reports as follows in the *Times* of October 24th, 1866:—

"The quality of the water supply in September has been tested, as usual, by Dr. FRANKLAND. He gives a remarkable instance of the effects of filtration (through ATKINS's Patent Cistern Filters) of the East London Company's water, supplied to the tenants of the BARONESS BURDETT COUTTS, in Columbia Square:—The organic matter was reduced to the minutest quantity; the



hardness from  $20^{\circ}$  to  $7^{\circ}$ . The filtration of the water supply for 700 people is here performed without the least difficulty.

The analysis of the waters is by Professor FRANKLAND, F.R.S., of the Royal College of Chemistry."

**From Secretary of National Orphan Home, Ham Common.**

OFFICE :—33, STRAND, W.C.,

*December 28th, 1872.*

GENTLEMEN,—In reply to your enquiries respecting the working of the system of filtration designed and carried out by you at the National Orphan Home, Ham Common, Surrey, I have much pleasure in informing you that the results have been in every way satisfactory, not only as regards the quality of the water and the working of the Filters, but especially, I consider, as regards the health of the children.

The marked reduction in the hardness has also had perceptible effects on the lavatory and culinary departments.

I remain, GENTLEMEN, Yours faithfully,

(Signed) S. TAYLOR, *Secretary.*

Messrs. F. H. ATKINS & Co., Engineers.

**Report from George B. Mead, Esq., M.D., L.R.C.P. London, &c., &c.,**

Upon ATKINS & Co.'s Patent Compound System of Filtration, as carried out at Newmarket for the supply of Captain Machell's Training Establishment.

NEWMARKET,

*February 17th, 1874.*

The experiments, which have been repeated at intervals during the past two months, and the correctness of their results, tested by others too numerous to recapitulate, convince me that the action of Messrs. Atkins & Co.'s process, as carried out at Captain Machell's, is—

1. To deprive water obviously seriously contaminated with sewage matter of the whole of such dangerous impurities, and render its use fit and safe by men and animals.
2. That by this means the quantity of lime and other solid matters, naturally contained in many waters, can be largely reduced, and if deemed advisable, by a slight addition to the apparatus, entirely removed.

I may here mention that, having regard to the fact that the water at Captain Machell's establishment was principally required for use by race-horses, many of them young growing animals, I did not consider it advisable, considering how largely lime enters into the formation of the bony skeleton, to have the water deprived of the whole of the lime naturally contained therein, and that in deciding on the amount of filtration necessary, this was kept in view.



I have now before me this day some of the water drawn from the lower tap immediately after it has passed the filter; it is very clear, without the slightest cloud, brisk and sparkling, with a pleasant, cool, refreshing taste, and is evidently well aerated, having apparently all the purity of distilled water, combined with the excellence and briskness of the purest spring water.

So far from rendering the water flat and disagreeable, when once the filters, charged on Messrs. Atkins's system, have been well saturated with water, *i.e.*, after a few days' use they do not impart any disagreeable, flat, brackish, or other objectionable flavour to water passed through them, both men and animals drink of it freely with cordial relish.

Though, previously to the adoption of this system, Captain Machell was a serious sufferer from the frequency of disease in his stable, I am pleased to be able to say that nothing of the kind has since been known.

One point further deserves mention, and that is the excellence of the manner in which the apparatus and fittings have been completed by Messrs. Atkins's workmen, as with inferior materials and bad workmanship, serious loss and annoyance must result.

GEO. B. MEAD, M.D., L.R.C.P. LONDON.

ABBOTSFIELD, WIVELISCOMBE,

*November 22nd, 1873.*

GENTLEMEN,—In reply to your request, conveyed in your letter of the 19th inst., I have pleasure in stating that the process of filtration which on so large a scale has been here carried out by you has proved most successful.

Every drop of water which enters my house for the use of my very large establishment is as pure as the most perfect filtration can make it.

Yours faithfully,

(Signed) CHAS. L. COLLARD.

Messrs. F. H. ATKINS & Co., Engineers.

LONGMEAD, BISHOPSTOKE,

*April, 1872.*

GENTLEMEN,—I have great pleasure in testifying to the efficiency of the Filtering Apparatus you have fixed at my house here. It completely prevents the choking of the pipes which formerly took place, and renders the whole water supply sweet and wholesome alike for drinking purposes and for the baths, &c.

Yours truly,

A. BARTON.

Messrs. ATKINS & Co., Engineers, London.

**Atkins & Co.'s Patent Improved System of Water  
Softening and Purification.**


---

*Estimates and Designs for carrying out this beautiful system  
for Private Mansions, Schools, Asylums, Colleges, Hospitals,  
Public Institutions, &c., &c.*

Also on a large scale for Water Works, for the supply of Towns, Villages, &c.; and for Manufacturing purposes of all kinds; prevention of Incrustation in Steam Boilers, stationary or locomotive; and for large supplies for Dye Works, Bleaching Works, Public Laundries, Starch Works, Breweries, Steamboat and Railway Companies, &c., &c., &c.

Messrs. ATKINS & Co. test samples of water at a nominal charge, and furnish complete analyses at prices from £2 2s. to £10 10s.

Plans, Estimates, and Designs for Water Softening and Purification in any quantity and for any purpose, at moderate charges for visits of inspection beyond railway fares, &c.

 In all cases it is absolutely necessary that a sample of the water to be treated be forwarded for examination before Estimates can be furnished. The quantity of water required is generally from one to two gallons.

F. H. ATKINS & Co.,

ENGINEERS,

Contractors for all kinds of Water or Gas Work.

---

PLANS, DESIGNS, & ESTIMATES FOR WATER WORKS,  
GAS WORKS, WELL-SINKING, &c.

---

All kinds of Pumping Machinery for Hand, Steam, or Horse Power;  
Hydraulic Rams, Turbines, &c., &c.

---

WATER TOWERS & RESERVOIRS DESIGNED & ERECTED.

---

Cisterns and Tanks of all sizes, in Enamelled Slate, Wrought,  
Cast, or Galvanized Iron, &c., &c.

---

Contractors to Her Majesty's Government.

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OFFICES :

62, FLEET STREET, LONDON, E.C.

WAREHOUSES :

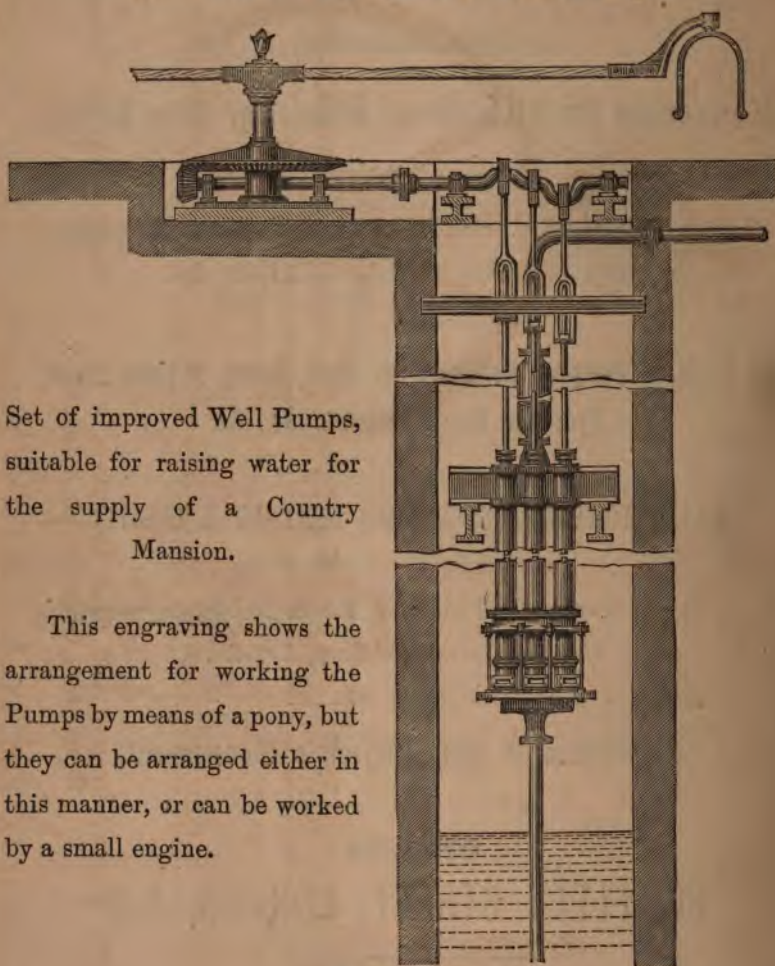
GRAND JUNCTION STREET, WHITEFRIARS,  
LONDON, E.C.

WORKS :

CHEPSTOW, MONMOUTHSHIRE.



# Atkins & Co.'s Improved Well-Pumps.



Set of improved Well Pumps,  
suitable for raising water for  
the supply of a Country  
Mansion.

This engraving shows the  
arrangement for working the  
Pumps by means of a pony, but  
they can be arranged either in  
this manner, or can be worked  
by a small engine.

FIG. 155.

These Pumps can be had single, double, or treble barrel, and  
are made also in several sizes, viz.,  $2\frac{1}{2}$ , 3,  $3\frac{1}{2}$ , 4, and  $4\frac{1}{2}$  inch. Full  
particulars, prices, and estimates free on application.

ATKINS & Co., Engineers, 62, Fleet Street, London, E.C.

# ATKINS & Co.'s Improved Water Works Pumping Engines.

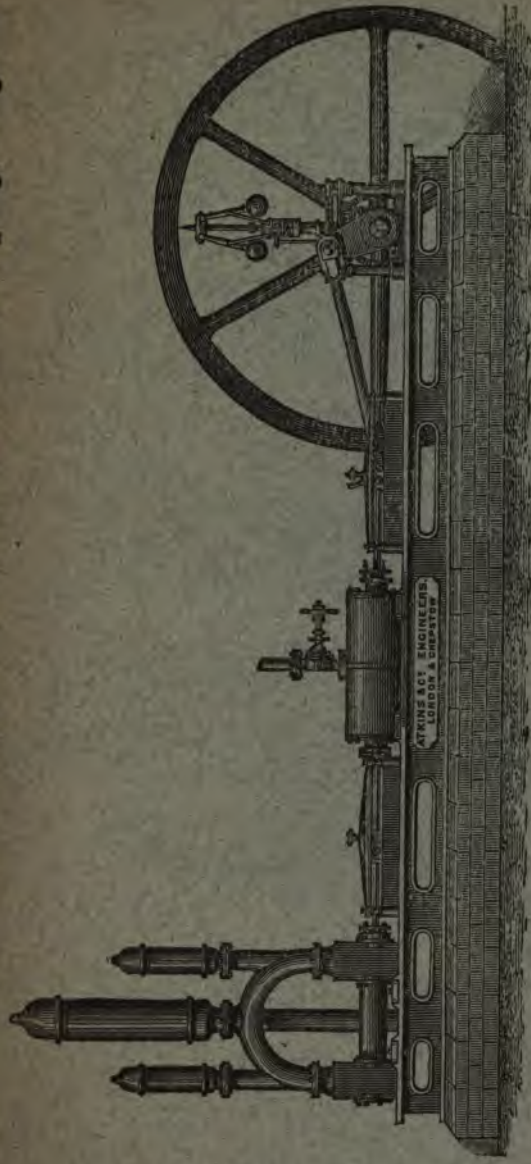


Fig. 172.

25-H.P. Pumping Engine, designed and fixed by ATKINS & Co. for Water Works at Hemel Hempstead, Great Berkhamstead, &c.

PRICES ON APPLICATION.













